DIESEL PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

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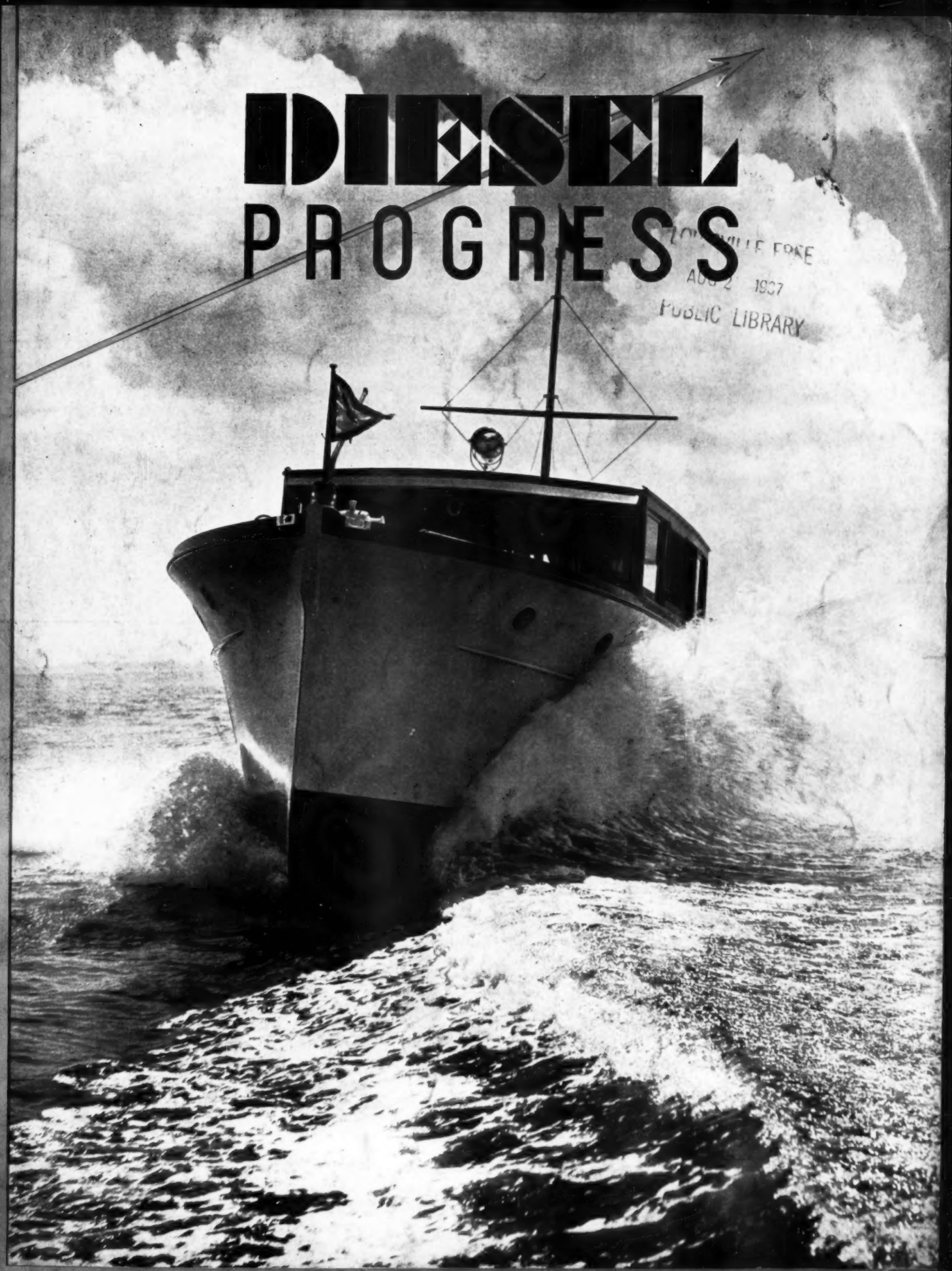


JUNE, 1937 CIRCULATION OF THIS ISSUE—IN EXCESS OF 11,000 COPIES 25c

Actual photograph of a Gulf lubrication engineer in consultation with the Chief Engineer of a widely known Diesel power plant. Every day, Gulf engineers are "in the picture" in scores of plants from Maine to Texas—helping to reduce operating costs through better lubrication.

"We Welcome THE GULF ENGINEER IN OUR PLANT..."

...he helps us keep maintenance costs down!" ... SAYS THE MANAGER OF THIS BIG PLANT

IT'S not his ready and tactful cooperation alone that makes the Gulf engineer a welcome visitor to this and many another Diesel power plant. The results of his work show up in lowered repair bills and better performance from power units. No wonder the door is always open to him!

Here is the Gulf engineer's aim: *to increase the efficiency* of Diesel operation through improved lubrication. His experience embraces scores of plants and he is prepared to recommend the proper lubricants and the best application methods for the equipment in your plant, regardless of its age, size or type.

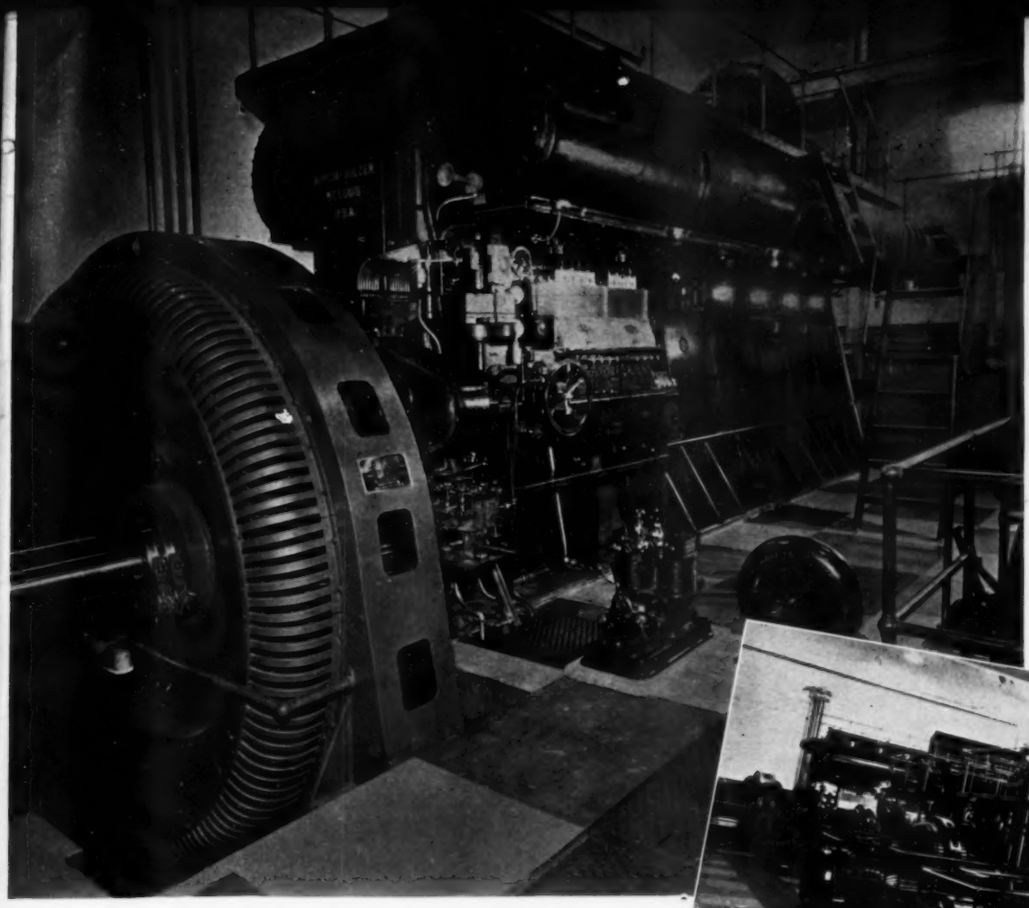
Any Diesel operator can have the benefit of this cooperative engineering service. It is extended to all users of Gulf quality lubricants — from Maine to Texas — without charge.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION
GULF REFINING COMPANY
GENERAL OFFICES: GULF BUILDING, PITTSBURGH, PA.

Makers of Gulf No-Nox Ethyl Gasoline and Gulfpride Oil

DIESEL PROGRESS for June, 1937. Volume III. No. 6. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Possessions $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U.S.A., 50 cents for all other countries.



Progressive *Hilo, Hawaii*

Turns to Busch-Sulzer Diesels for Dependable Light and Power Service

2400 B.H.P. Busch-Sulzer two-cycle trunk-piston Diesel generating unit, installed 1937.

THE addition of a fourth Busch-Sulzer Diesel in the Puueo plant of the Hilo Electric Light Co., Hilo, T.H., brings the total capacity of the station to 4200 BHP. The first 600 BHP unit was installed in 1931 and the several repeat orders testify to the reliability and dependability of Busch-Sulzer quality Diesels in such remote locations.

With adequate technical staff and specially equipped Diesel works, we are guided in design, selection of materials, and workmanship by almost 40 years of Diesel building experience.

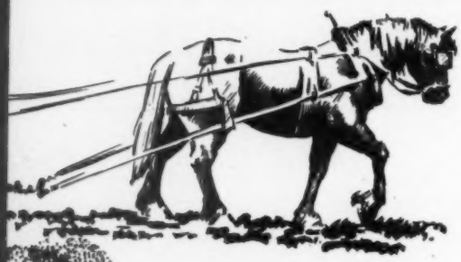
Original Diesel Builders in the United States—1898-1937
Sizes up to 10,000 B. H. P.

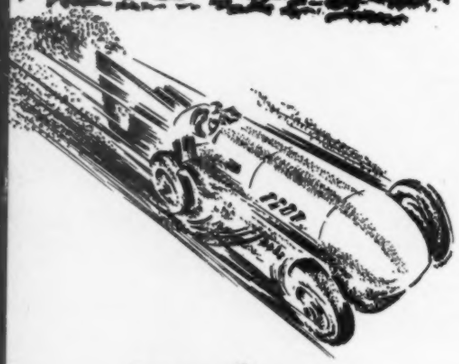
BUSCH-SULZER

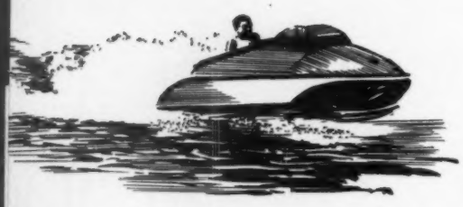
BUSCH-SULZER BROS.-DIESEL ENGINE CO. . . . ST. LOUIS

2 RECTOR STREET, NEW YORK • RIALTO BUILDING, SAN FRANCISCO

SLOW SPEED *Means Long Life!*







Speed is the heritage of the thorough-bred, a high spirited animal whose value is determined by his winnings at the race track. In a few short seasons his work is done—retired with honors, or wind-broken, he passes into oblivion.

The draft horse is bred to do the world's work. With a heavier frame, he is not as picturesque as the race horse. He may be just a "plug," but for twenty years he may render a dependable service.

The racing car is designed with but one idea in mind—to finish a race in winning time. The engine is "souped up" to deliver a maximum R.P.M. Constantly in need of tuning, it spends more time in the shop than on the track.

The dump truck is built to carry the heavy burdens imposed by the construction industry. Sturdy in construction and with an engine designed for heavy-duty service, the dump truck remains in service for years after the wreckers have sold the parts of the racing car.

The speed boat is a thriller to the sportsmen who like the water. Light in weight and finely polished, with a high speed engine with which she skims the water, she is a constant source of work, worry and repairs.

The heavy duty workboat, powered by a slow speed Atlas Diesel, is destined for many years of economical, continuous service. Speed is sacrificed for Dependability—that's why you see the Atlas Diesel powered boats plying the rivers, harbors, bays and inland waterways, when boats with high speed engines are tied up for repairs.

ATLAS IMPERIAL DIESEL ENGINE CO.
OAKLAND, CALIFORNIA • MATTOON, ILLINOIS

ATLAS IMPERIAL

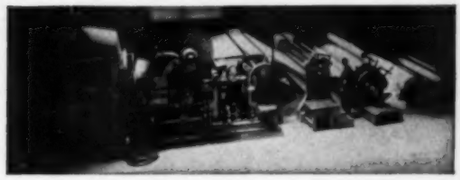
DEPENDABLE DIESEL POWER FOR THE WORK BOAT OWNER

500,000 MEN WROTE THESE "CASE HISTORIES" ON OIL!

For Industrialists who want better Plant Earnings

BACKGROUND OF THE WORLD'S GREATEST LUBRICATION KNOWLEDGE

- Written by 500,000 plant operators in 63 countries of the world.
- 25,000 new and valuable "studies" added every year.
- Used as lubrication guide-books by leading engineering schools.
- Scientific and practical results—based on the greatest experience in the oil industry.



How to put this Knowledge... part of Socony-Vacuum Lubrication Service... to work in your Plant

IT HAS TAKEN 71 years to gather, correlate and file the tremendous lubrication knowledge Socony-Vacuum offers industrial men.

The scientific and practical information it provides is worth literally millions of dollars to American industry, for it points the way to decreased power consumption, lowered maintenance expense, improved production methods, smaller annual oil bills.

It will pay you to take advantage of this knowledge and experience—when Socony-Vacuum representatives call at your plant.

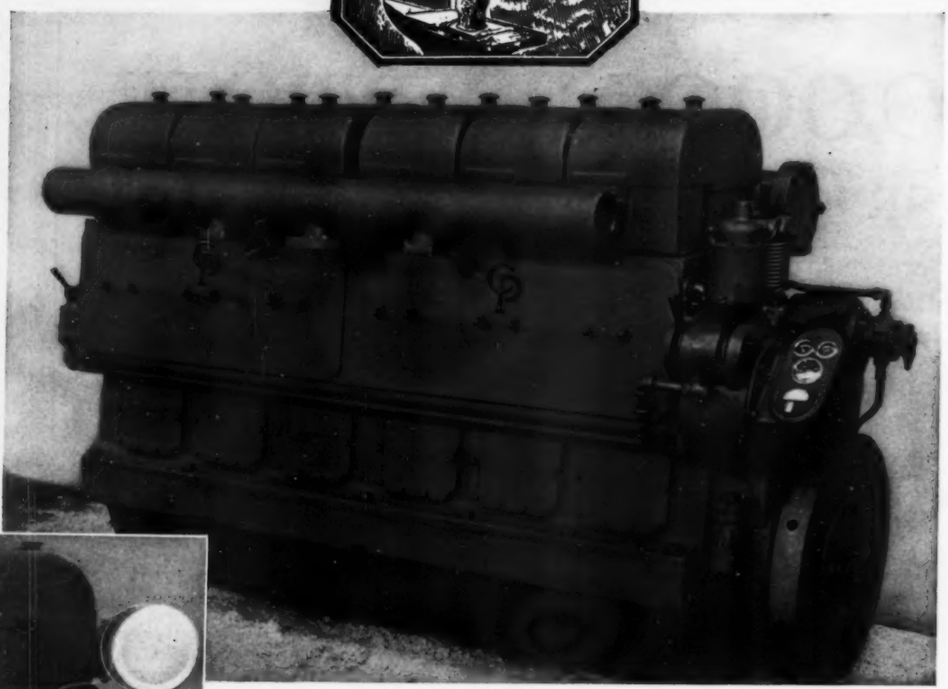
SOCONY-VACUUM

INDUSTRIAL LUBRICATION

GARGOYLE Lubricants

SAVES MONEY FOR INDUSTRY

71 Years' Lubricating Experience...the Greatest in the Oil Business



SATCO* IN THE NEW C. P. T. DIESEL

IT IS a matter of deep satisfaction to us that Satco* lined bearings are being used in the new engines made by Chicago Pneumatic Tool Company. But far more important is the satisfaction assured the operators of these new Diesels . . . satisfaction due, in part, to the Satco bearings with which they are equipped. So satisfactory has been the performance of this modern alloy that Diesel operators say, "Satco for satisfaction."

*A patented alloy manufactured by National Lead Co. Trade-mark registered.

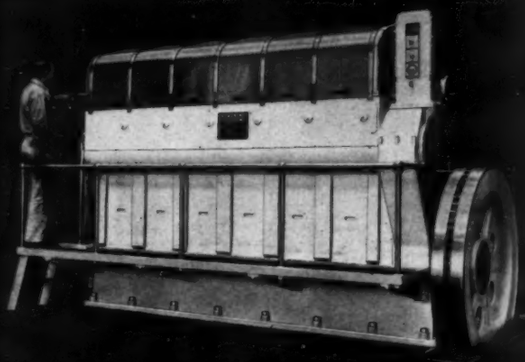
AMERICAN BEARING CORPORATION

AFFILIATED WITH NATIONAL LEAD COMPANY

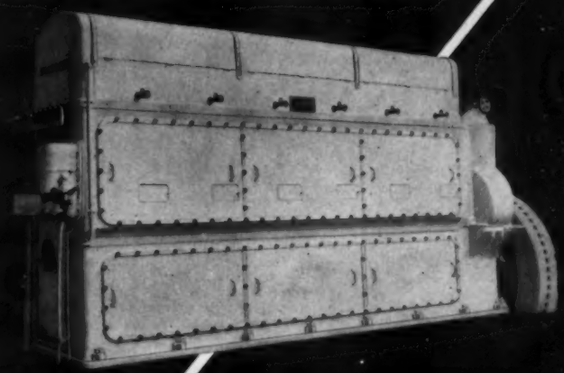
INDIANAPOLIS INDIANA

CENTRIFUGAL American Bearings FORCE

THE NORDBERG LINE
Of Better Built Diesels



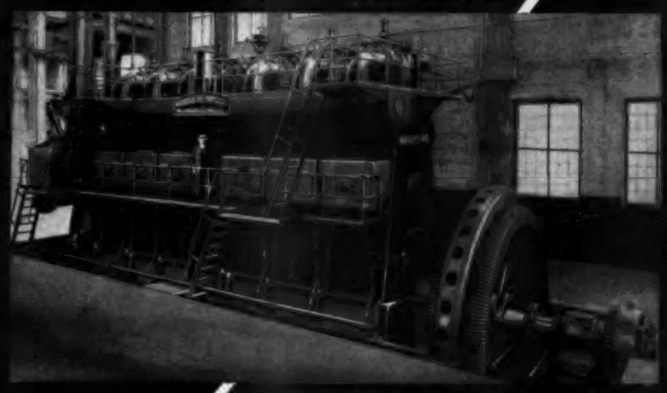
Four Cycle — Six Cylinder — 300 H. P.



Four Cycle — Six Cylinder — 750 H. P.

Two and Four Cycle

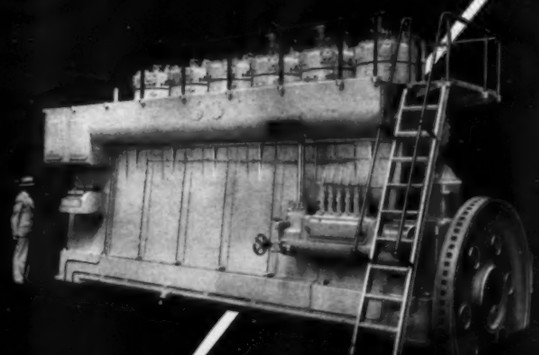
Air and Solid Injection



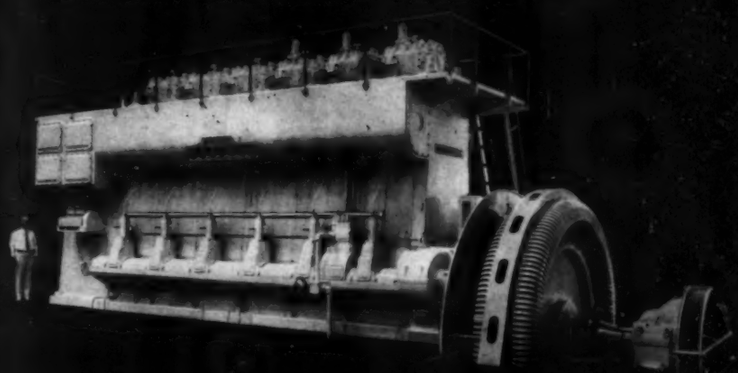
Trunk Piston and Crosshead Construction

From 150 Horsepower Upward

Two Cycle — Six Cylinder — 4000 H. P.



Two Cycle — Six Cylinder — 1500 H. P.



Two Cycle — Six Cylinder — 2250 H. P.

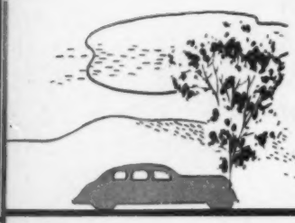
NORDBERG MFG CO., MILWAUKEE

NEW YORK 60 E. 42nd St. | WASHINGTON 917 Barr Bldg. | CLEVELAND 318 Rockefeller Bldg. | KANSAS CITY 3560 Broadway | DALLAS 3801 Potomac Ave. | LOS ANGELES Subway Terminal Bldg.

*Performance** PROVES MOTOR OIL QUALITY!

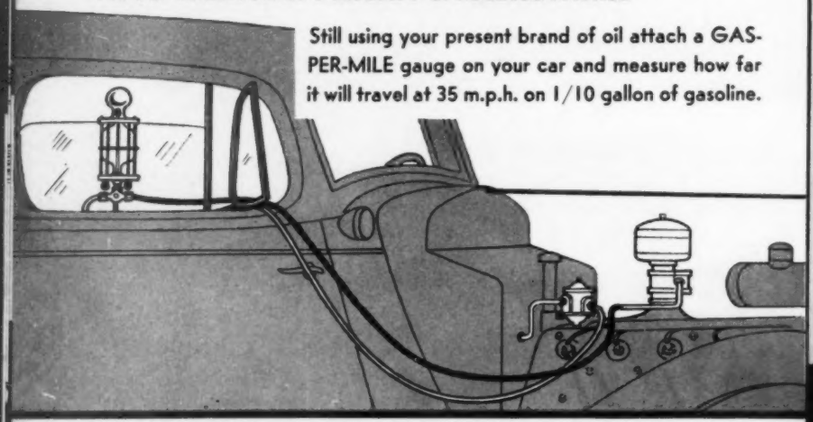
*** RING-FREE TEST No. 7 . . . One of a Series Pioneered by Macmillan**

Part 1. ACCELERATION as a Measure of Reduced Friction.



With your present brand of oil in the crankcase roll past a given point on a level stretch of open highway at 10 m.p.h. and then accelerate your car to 60 m.p.h. as quickly as possible. Mark the point on the road where your car reaches 60 m.p.h. by throwing a small cloth bag of flour on the pavement.

Part 2. MILEAGE as a Measure of Reduced Friction



Still using your present brand of oil attach a GAS-PER-MILE gauge on your car and measure how far it will travel at 35 m.p.h. on 1/10 gallon of gasoline.

And then drain your oil, put the same S.A.E. grade of Macmillan RING-FREE Motor Oil in the crankcase and repeat the tests over the same course. The quicker acceleration and increased mileage with RING-FREE is perfect proof of better lubrication. The Macmillan man will give you more details about these tests.

MACMILLAN PETROLEUM CORP., 530 WEST 6TH ST., LOS ANGELES, CAL.

50 WEST 50TH ST., NEW YORK CITY, N. Y., OR EL DORADO, ARKANSAS

Which motor oil is best? Every motor operator has asked that question. And, now, here is an easy, quick way to answer it.

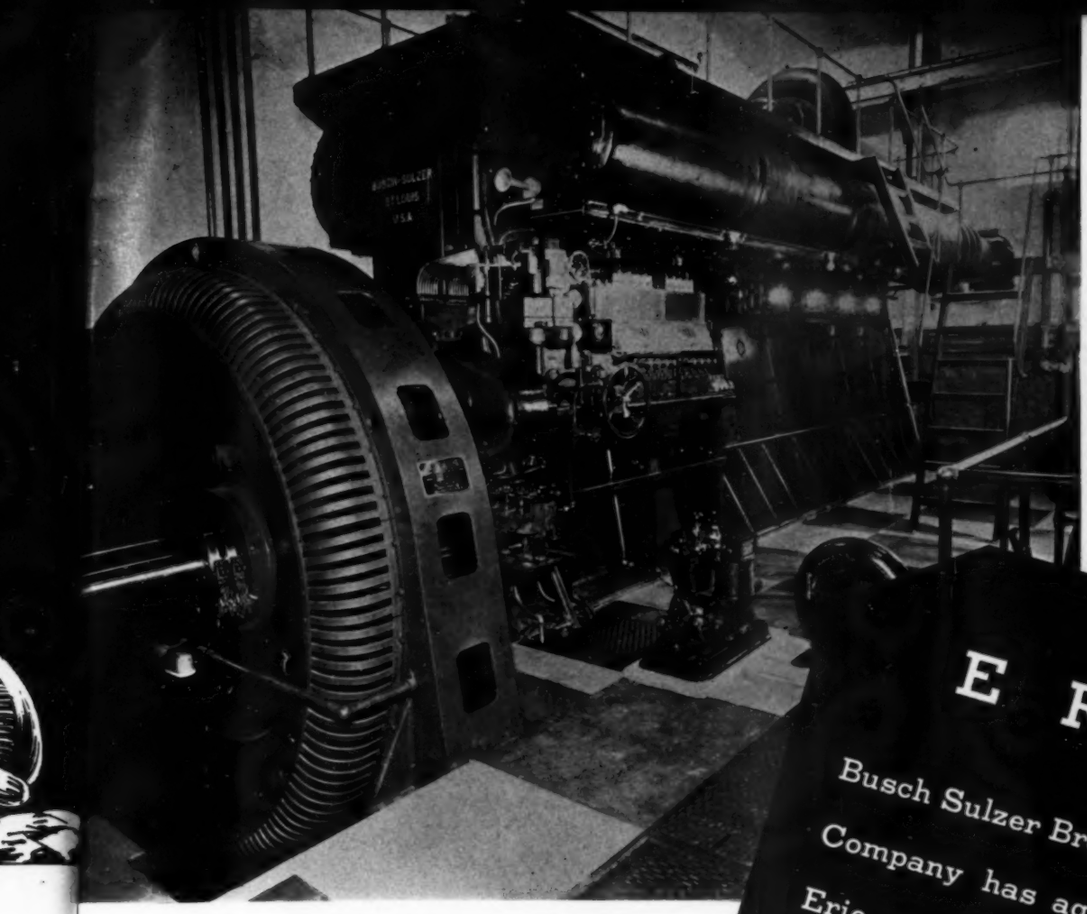
Macmillan RING-FREE Test No. 7 is based on the fact "the best motor oil lubricates best." In other words, the oil that reduces internal motor friction more than other oils is the best oil.

A nationally famous automotive engineer says of internal motor friction, "with regard to engine friction, at 40 miles per hour, 50 per cent of the horsepower developed by the engine is used in overcoming this loss." Think of it! Half of every dollar you spend for fuel is eaten up by friction inside the motor. If you lubricate the motor better then more horsepower will be saved to improve the performance of the car. That is the basis of RING-FREE Test No. 7. Simply compare the evidence of the amount of horsepower delivered by your motor when it is lubricated first with one oil and then another.

Try this test in your own motor! In stationary engines look for the increased revolutions at the same throttle setting. You'll be both pleasantly and profitably surprised at the extra lubrication you get from Macmillan RING-FREE Motor Oil. Remember, friction causes wear and less friction means less wear and less repair.

MACMILLAN RING-FREE MOTOR OIL

1. GREATER FILM STRENGTH
2. HIGHER HEAT RESISTANCE
3. LONGER CLING TO METAL
4. FASTER PENETRATION
5. REMOVES HARD CARBON
6. IS NOT CORROSIVE



ERIE

Busch Sulzer Bros. Diesel Engine Company has again selected an Erie crankshaft for the largest Diesel engine ever installed in the Hawaiian Islands.

Dependability and long life, proved in innumerable marine and stationary installations, account for the repeated use of Erie equipment by leading engine builders.

ROUGH and finished connecting rods, piston rods, crossheads, generator and extension shafts for all classes of stationary and marine engines. Complete facilities for prompt delivery on all major forged or cast steel elements required in the building and powering of every type of construction.

ERIE FORGE COMPANY, ERIE, PENNSYLVANIA

WORLD'S ONLY MARINE POST OFFICE POWERED BY HERCULES DIESEL

Let the weather be stormy or fair, the O. F. Mook, powered with a Kermath Hercules Diesel Engine, delivers the mail to the passing marine traffic on the busy Detroit River. This boat is a completely equipped post office and must live up to the postal creed of unfailing mail service. The choice of Hercules power for this 65-foot steel boat was a natural one. Hercules Engines, both Diesel and gasoline, have earned an enviable reputation for dependability, smooth operation and long life. These qualities result from over twenty years' experience in designing and building fine engines. They are qualities essential to marine engines.

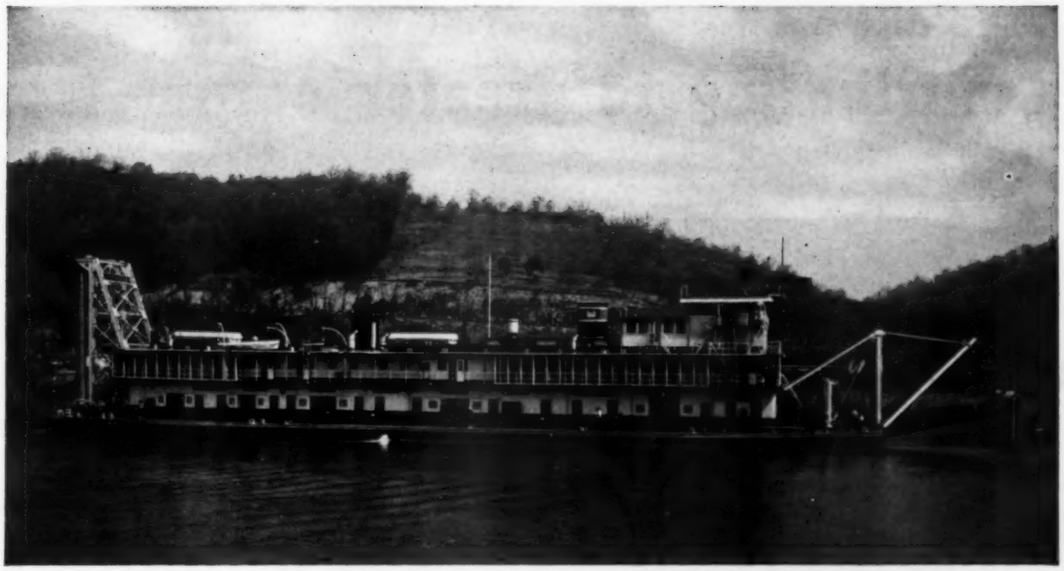
Hercules Marine Diesel Engines supplied by Kermath Manufacturing Company, Detroit, Michigan

HERCULES MOTORS CORPORATION, CANTON, OHIO

America's Foremost Engine Manufacturer

Power Plants from 4 to 200 H. P.

HERCULES DIESEL ENGINES



U. S. Engineer Dredge . . . WILLIAM A. THOMPSON . . .
the second of three Self-Propelled 20" Dredges recently completed

DRAVO

DESIGNERS
ENGINEERS
BUILDERS

is a Name Long Associated with the Building of Fine Dredges . . .

for DRAVO has built many of the finest.

STEAM and DIESEL

SELF-PROPELLED and NON-PROPELLED

SUCTION DREDGES of the CUTTER HEAD and DUSTPAN Types

DIPPER, LADDER BUCKET and GOLD DREDGES

Eastern Deliveries from WILMINGTON, DEL. . . . Western Deliveries from PITTSBURGH, PA.

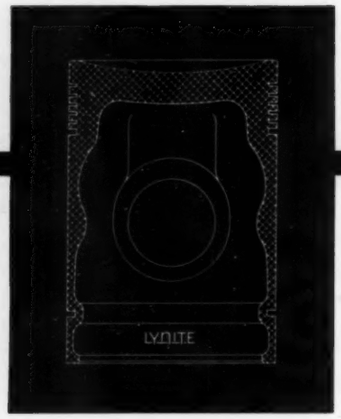
Specialists in the building of Steel Floating and Material Handling Equipment

DRAVO CORPORATION

ENGINEERING WORKS DIVISION

SHIPYARDS: PITTSBURGH, PENNA., WILMINGTON, DEL. . . . GENERAL OFFICES AND SHOPS, NEVILLE ISLAND, PITTSBURGH, PA.

Contributing to greater output from Diesel engines



Inertia of reciprocating parts is one factor which definitely limits the speed at which Diesel engines can be operated with dependability. The pounding pressure of heavy pistons operating at high speed imposes undesirable loads on bearings. Lightness in pistons is, therefore, highly desirable.

Lynite pistons, cast of light alloys of Alcoa Aluminum, are playing an important part in today's trend toward higher engine speeds. Their lightness results in lower bearing pressures, with consequent longer life for bearings.

Lynite pistons bring to the Diesel engine another natural characteristic of Aluminum: ability to conduct heat rapidly. The consequent uniform distribution of heat minimizes internal thermal stresses in the piston, which so frequently cause piston failure. Obviously, this is a direct contribution to Diesel reliability.

ALUMINUM COMPANY OF AMERICA, 2141 Gulf Building, Pittsburgh, Pennsylvania.

To be sure . . . SPECIFY

LYNITE PISTONS

CAST OF ALCOA ALUMINUM

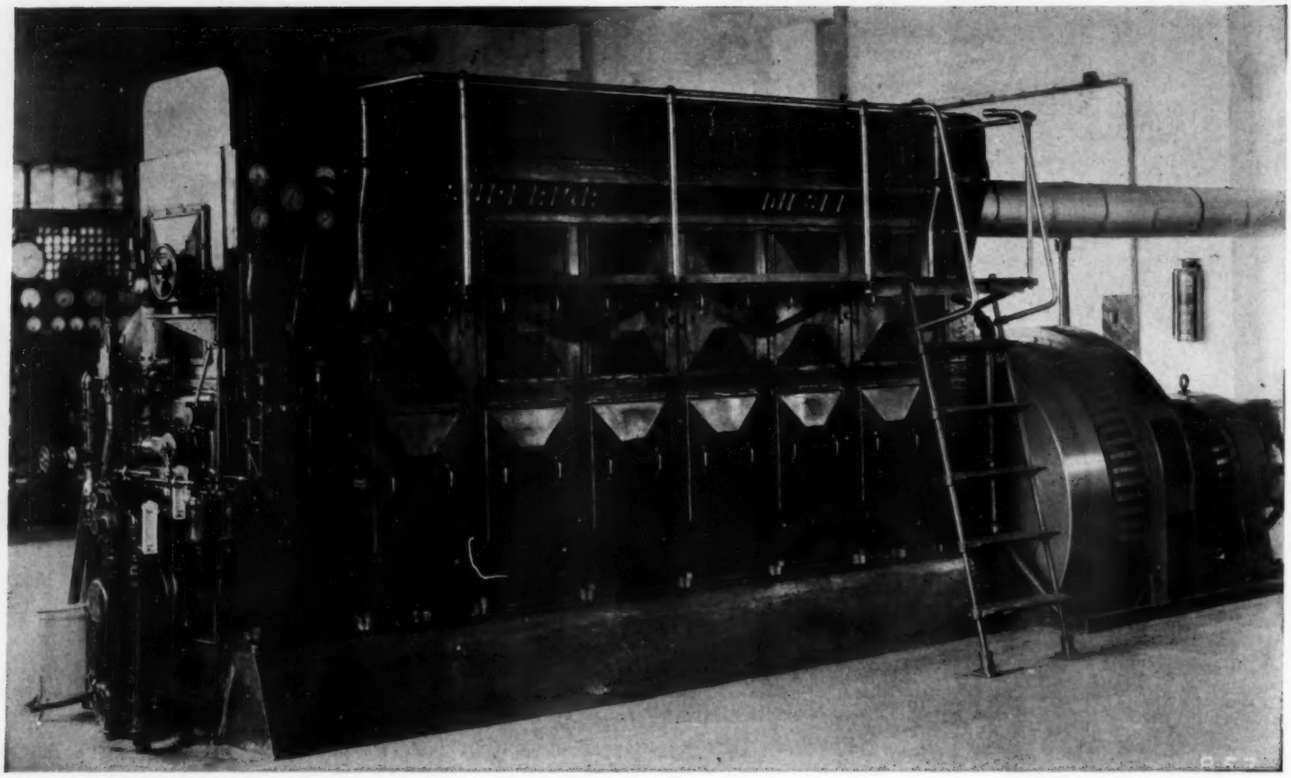
HARRISON
HEAT EXCHANGERS

meet Diesel cooling requirements in varied fields

On many types of Diesel installations—in many different fields—Harrison Heat Exchangers are rendering efficient oil cooling service. They contribute materially to economical operation by maintaining oil temperatures at levels best suited to proper lubrication. Sturdy and compact, they are now supplying dependable cooling on Diesels ranging from 40 to 1500 horsepower.

Harrison's Engineering Department will be glad to make recommendations as to the type and size of Heat Exchanger necessary to meet your requirements. Complete data furnished, without obligation.

HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION • LOCKPORT, N. Y.



A 380 horsepower, 6-cylinder Superior Diesel, like the one illustrated, has been purchased by the City of Sandersville to increase the capacity of its municipally operated power plant.

This City is to be congratulated on its ability to keep its power plant always abreast of the needs of its customers and equipped with the most modern of equipment to keep the cost of its service low.

Superior Diesel engines present marked advantages to municipalities and industrial power users. Don't fail to find out about them.

THE NATIONAL SUPPLY COMPANY

OF DELAWARE

SUPERIOR ENGINE DIVISION, SPRINGFIELD, OHIO

LOS ANGELES, CALIFORNIA — PHILADELPHIA, PA.

Superior DIESELS

HEAVY DUTY MODELS: 50 to 810 H.P., 250 to 720 R.P.M. • HIGH SPEED MODELS: 25 to 150 H.P., 1200 to 1800 R.P.M.

Burlington, Kansas—Municipal Power Plant.

Two 875 hp. 5 cylinder Model 32 E Fairbanks-Morse Diesel Engines each equipped with a Model RB Alnor Exhaust Pyrometer.

E. T. Archer & Co., Consulting Engineers.

Burlington, Kansas

Fairbanks-Morse Diesel Plant Served by "Alnor" Pyrometers

THIS attractive well engineered Diesel plant which went into service in March 1936 is a typical example of a profitable municipally owned power plant.

It consists of two 875 hp. five cylinder Model 32 Fairbanks-Morse Diesel engines directly connected to generators.

Among the accessory equipment used to insure highest efficiency and operating economy are two Alnor Model RB Exhaust Pyrometers, one for each engine. These pyrometers are mounted with other gauges on an alarm panel conveniently located near the engines.

If you are operating Diesel Engines—small or large—without pyrometers, or if you are considering an installation, insist that they be equipped with Alnor Pyrometers.

Catalog on Request

ILLINOIS TESTING LABORATORIES, Inc.

423 North LaSalle Street • Chicago, Illinois

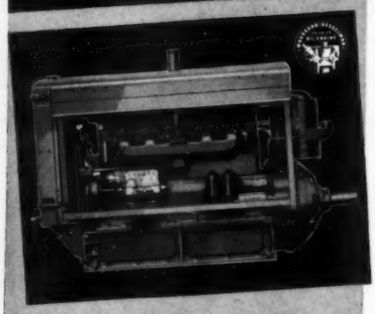
Testing Engineers and Manufacturers of "Alnor" and "Price" Pyrometers.
The Products of 37 Years' Experience.

"Alnor" Pyrometers—*The Engine X-Ray*

YOU CAN'T MOVE ROCK WITH PAPER HORSEPOWER...

Waukesha-powered Marion *2-yd. shovel, building a road near Bridgeport, Wisconsin*

It takes REAL HORSEPOWER TO DIG LIMESTONE . . . .



WAUKESHA ENGINES

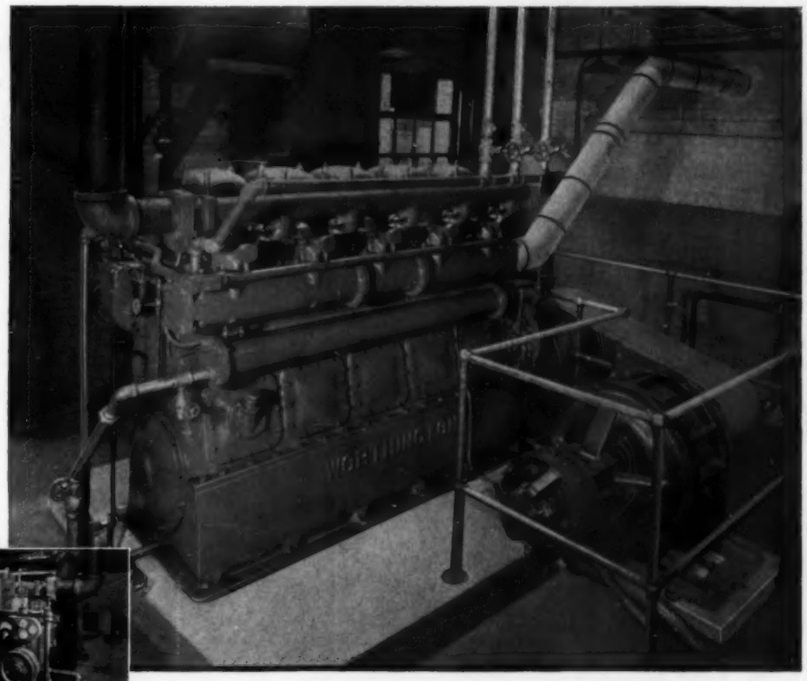
You can give an engine an impressive performance curve—and put it in a shovel. But if it's only paper horsepower it won't move a yard.

This shovel is digging limestone without the use of drills or dynamite! That takes *real horsepower*—Waukesha horsepower—delivered by an engine built with rugged parts not overstrained by over rating.

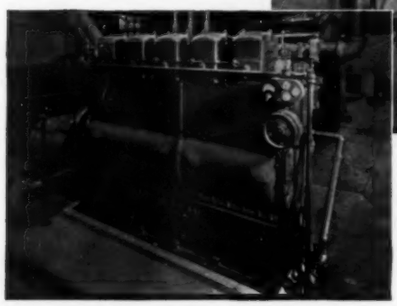
The shovel, a Type 381, 2-yd. Marion, is going through 50,000 yards of rock, moving 300,000 yards on a road building job near Bridgeport, Wisconsin, and five wagons and three tractors are being kept busy on a quarter mile haul. The shovel is powered by a 6-cyl., 125-190 hp. EKH Waukesha-Hesselman Oil Engine, burning No. 3 furnace oil.

A low compression, solid injection oil engine, with precisely timed electric ignition, the Waukesha-Hesselman gives easier starting, smoother running and lower up-keep . . . with low cost, high speed diesel fuels. Write for Bulletin 1011-B.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN
NEW YORK • TULSA • LOS ANGELES



At **Positive Lock Washer Company's** *Newark, New Jersey, plant, this modern Diesel power installation is completely Worthington. The 150-hp. Worthington Diesel is driving the generator through a Worthington Multi-V-Belt Drive. All auxiliary equipment is by Worthington.*



Another Worthington Diesel is contributing substantially to profitable plant operation

... adding to a long list of installations in which Worthington engine economy is being consistently demonstrated.

IN some plants, power costs have been cut to less than half of former costs ... thus directly augmenting profits.

A Worthington engineer will be glad to study your power problem, and submit complete recommendations to meet your exact requirements.

●

Worthington engines are built for continuous operation at medium speeds. A complete line provides the correct unit for every individual condition ... and Worthington air compressors for starting, rotary pumps for fuel transfer, and centrifugal pumps for jacket cooling, give additional service security through the undivided responsibility of one maker.

DIESEL ENGINES ... 50 to 1500 hp.
Every type of drive

OTHER WORTHINGTON PRODUCTS:

AIR CONDITIONING EQUIPMENT
REFRIGERATION AND ICE PLANT EQUIPMENT
AIR AND GAS COMPRESSORS
STEAM TURBINES
STEAM CONDENSERS
STEAM-JET EJECTORS
FEEDWATER HEATERS
PUMPING EQUIPMENT
V-BELT DRIVES
LIQUID METERS
ROCK DRILLING EQUIPMENT
CONTRACTORS AIR TOOLS

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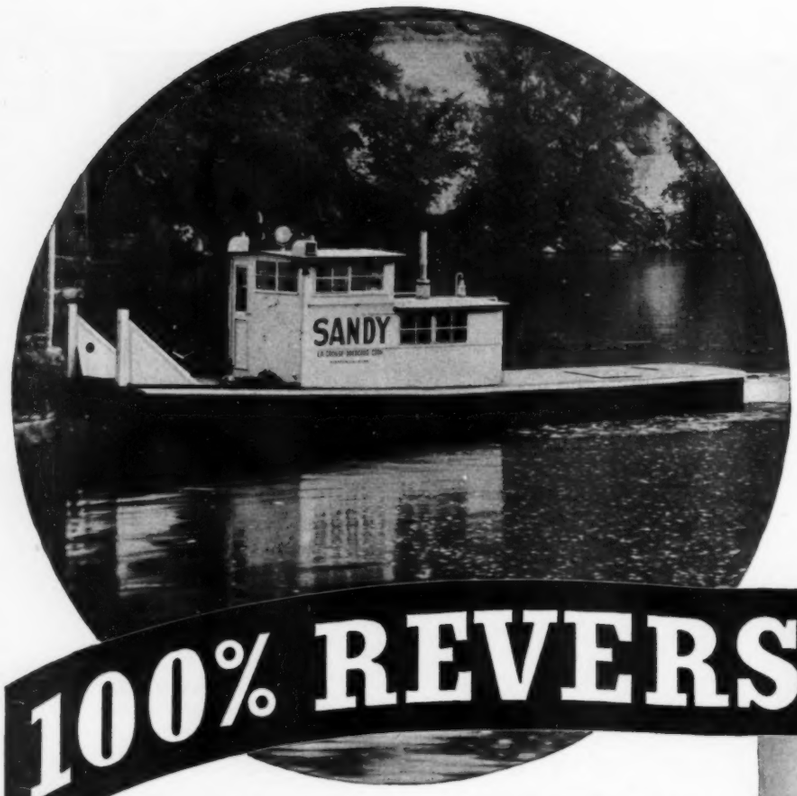


On the Mississippi River at Minneapolis—the La Crosse Dredging Company's dredge tender *Sandy*. She handles with greater ease and accuracy . . . with the same speed reverse as forward . . . because of the Twin Disc Marine and Reverse Gear Unit applied to the 120 hp, 6-cyl., Model 36 Fairbanks-Morse Diesel Engine.

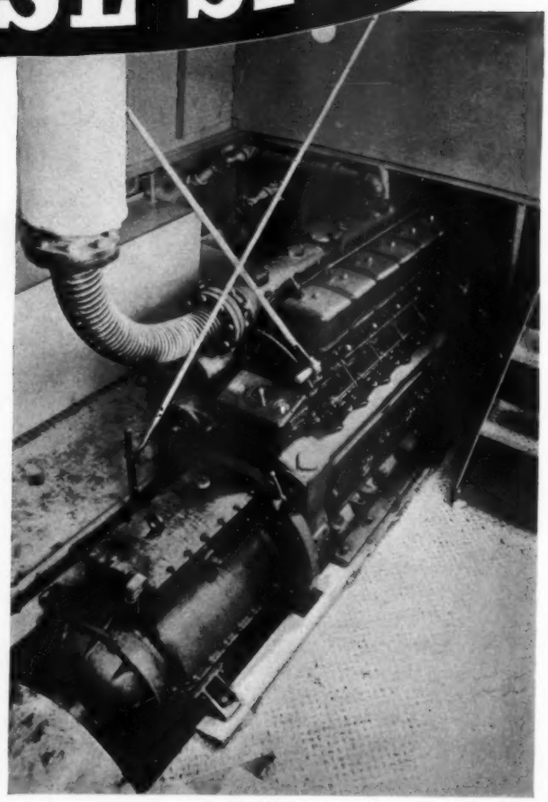
100% REVERSE SPEED

CONTINUOUSLY . . . INDEFINITELY

Designed to permit a reverse speed that is 100 per cent of forward speed . . . *continuously and for long periods of time* . . . Twin Disc Marine Reverse and Reduction Gear Units are admirably suited for high speed Marine Diesel Engine applications.

Simple in construction—two close coupled multiple disc clutches, operating in oil . . . five gears . . . with large size, extra capacity, anti-friction bearings throughout—these units require no adjustments of any kind. Lubrication has no connection with the engine. Only clean oil is used. The self-contained oil circulation pump operates continuously.

Model MG-160 (shown), power operated by means of a hydraulic cylinder, is suitable for Diesel engines rated 160 hp at 1200 rpm; standard gear ratios, 2:1 or 3:1. Model MG-60 is a manually operated gear for engines rated 60 hp at 1200 rpm, 2:1 or 2½:1 ratios. *Write for Bulletins 103 (MG-160) and 104 (MG-60).*



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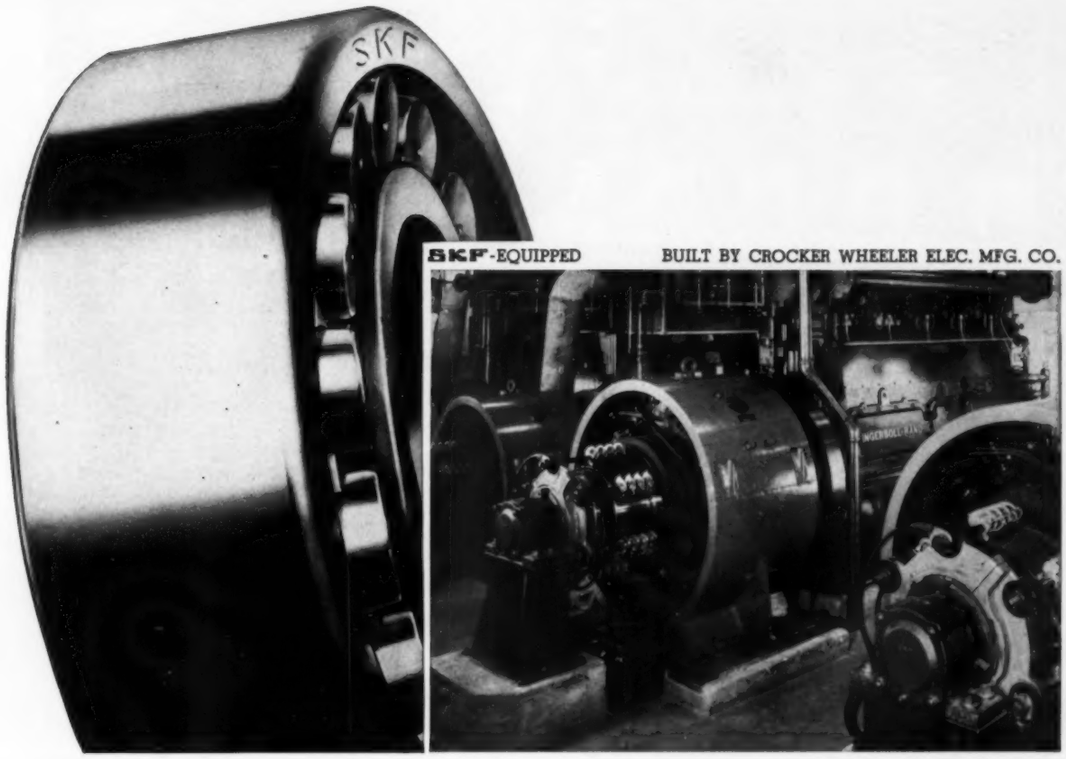
1345 RACINE STREET, RACINE, WISCONSIN

MARINE REVERSE and REDUCTION GEARS



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Generator UNITS GIVE PROFITABLE PERFORMANCE ON SKF

• Carefully designed for shafts up to 30" in diameter, SKF Bearings and Pillow Blocks pay for themselves within a reasonably short time. Ask for our new catalog, "SKF Transmission Appliances."

● Trouble-free bearings and pillow blocks support the rotor shafts of these Ingersoll-Rand Diesel generator units. They are SKF — and this means the hypothetical running-in period is not required, for SKF Bearings function from the very start with minimum lubrication and maintenance requirements.

The self-aligning characteristics of SKF Spherical Roller Bearings not only provide an equalized load distribution, but assure full bearing capacity conducive to long life. In addition, the adapter sleeves on which the bearings are mounted, permit ease of assembly and disassembly when required. No matter how small or big the job, SKF puts the right bearing in the right place.

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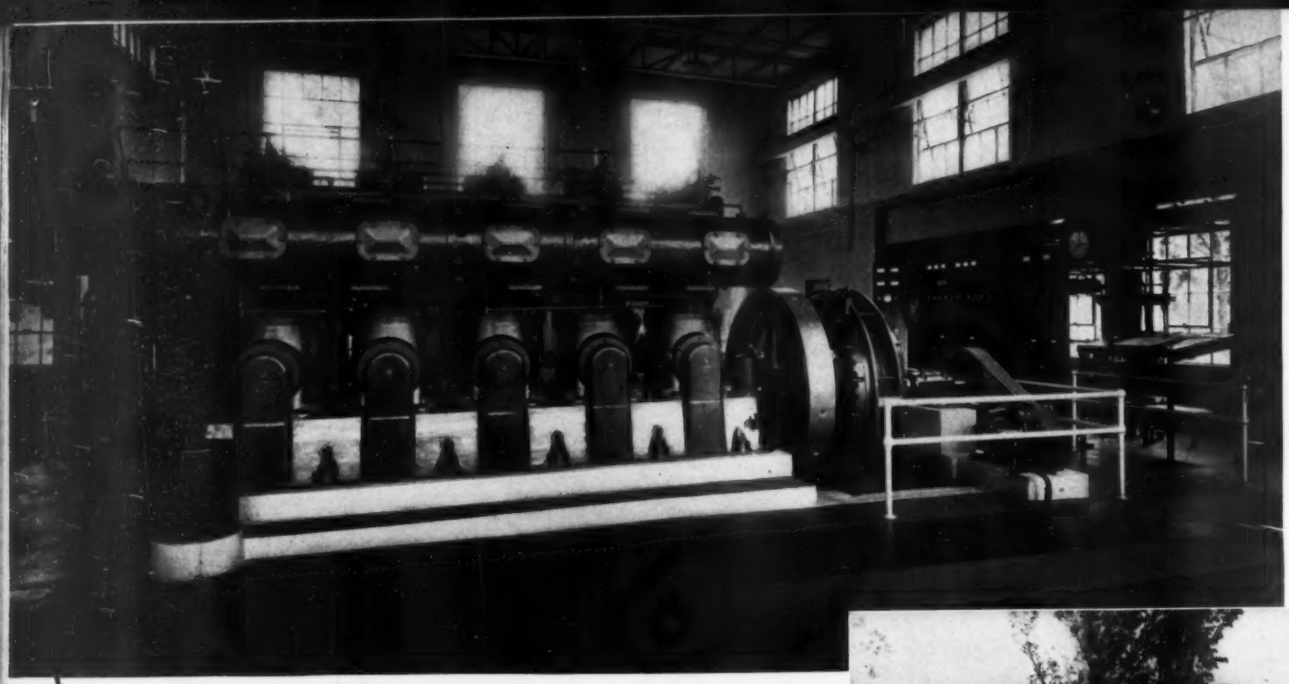

$10,000 ANNUAL PROFIT!

• That's what two Fairbanks-Morse Diesel engines earn in the Burlington, Kansas, municipal plant. Ten thousand dollars will go a long way toward paying municipal obligations—toward reducing taxes for Burlington's 2500 citizens.

This same economy of operation, this same dependability is available with Fairbanks-Morse Diesels wherever power is used. Whether the requirement is for several thousand horsepower, or as little as ten; whether for marine service, stationary or portable, there are Diesels from the Fairbanks-Morse complete line that exactly fill the need.

Don't be satisfied with less than the best Diesel engine for the job. Take your power problem to "Diesel headquarters," where you will get the right engine the first time—without compromise. Get the facts on F-M Diesels and what they are accomplishing throughout the world.

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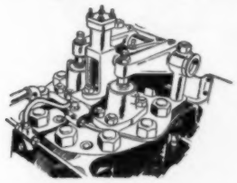
Diesels

RIGHT DOWN YOUR ALLEY



It's the High Quality of Nonpareil Diesel Oil that Reduces Consumption

A large Public Service Company operates four Diesel Engines in one power plant. A test of Nonpareil Diesel Oil on these engines was proposed last year by a Standard Lubrication Engineer in the belief that both lubricating and maintenance costs could be reduced.

The plant engineer consented to a test, but with the understanding that no adjustments be made on the engine. This, he thought, would give a fairer comparison of the oils.

Even on this basis, Nonpareil registered improvement, particularly in reduced carbon formation in the exhaust ports. Then, when the Lubrication Engineer convinced the management that Nonpareil could do a *better* job, he was allowed to inspect and adjust one unit. The lubricator was carefully cut down to reduce the oil feed, with constant check of the engine for adequate lubrication. Each adjustment brought improved operation until finally oil consumption on the large, 6 cylinder, 16" x 20", two cycle engine had been brought to less than a gallon of oil for 4000 H.P. hours.

The extra lubrication quality of Nonpareil permitted a safe reduction in oil feeds *on all four units* in this plant. This meant a considerable saving in oil consumption alone, and in addition, carbon formation and the extra maintenance expense it caused, were practically eliminated.

Ask your Standard Lubrication Engineer to test Nonpareil Diesel Oil in your plant. He may show you worth-while savings.

Write for your copy of—

"SERVICE TESTS OF DIESEL OILS"

It gives the important factors in testing Diesel Oils in service and the comparisons to be made, such as ring and cylinder wear, carbon formation, fuel and oil consumption. A valuable and informative booklet for those interested in reducing Diesel Lubricating costs. Write, for this or booklets listed below, to Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

"Diesel Engine Bearing Lubrication"
"Diesel Cylinder Lubrication"
"Air Compressor Lubrication"

"Isn't this a slow way to save money, Dad?"

"No, Son . . . big industrial plants save in just such small ways.

I KNOW... I help them!"

SONNY wasn't to be criticized . . . a penny or two a day did seem like a woefully small amount . . . particularly when dad talked of dollars, even hundreds of dollars, that he had helped other people save.

But dad was a Lubrication Engineer. The lesson he tried to impress on Sonny was not far removed from the one he preached and practiced every day. It was his job to make savings—not in pennies but in lubricants—and he had proved the effectiveness of multiplied *small* savings, in the hundreds of plants he served.

He had found that no item of lubrication was too small to be checked. He knew that by making seemingly insignificant corrections—reducing an oil feed here—using a more effective type of grease there—being continually watchful for mechanical wear that stealthily took an increasing share of lubricant—he *could* and *did* help many department and plant executives make substantial reductions in their lubricating costs. When these individual economies were added together they bulked large in yearly totals.

Here is an engineer trained in the job of finding leaks in lubrication costs. There's one or more right in your local Standard Oil Office. Why not take advantage of this valuable help and advice today? There is no obligation. Ask any Standard Oil representative or call your local Standard Oil (Indiana) Office.

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YOU CAN DEPEND UPON *This*

Keeping rings working "like new" and pistons unmarked by blow-by is largely a question of the oil you use. Algol and Ursa withstand high temperatures, lubricate effectively and don't form hard carbon. Texaco lubricated engines are notably economical in fuel consumption.

CLEAN, active rings that form a perfect piston seal and mean continued high compression . . . you will get this to a new degree, when you use Texaco Algol or Ursa Oils in your Diesels.

Your first inspection after beginning their use will show rings and valves active, ports open, the entire engine *clean.* Algol and Ursa Oils are wholly distilled, refined, filtered, to free them from hard carbon and sludging elements that can cause trouble.

Many lubricants break down in the heat of Diesel cylinders, form tar, gum, and sludge deposits that burn into flint-hard carbon. You often have to tear down when you use such oils. Using Texaco Diesel Lubricants, what little carbon there is will be dry, powdery, most of it blowing out of the system as it forms.

This is one important reason why more Diesel h.p. is lubricated with Texaco than with any other brand.

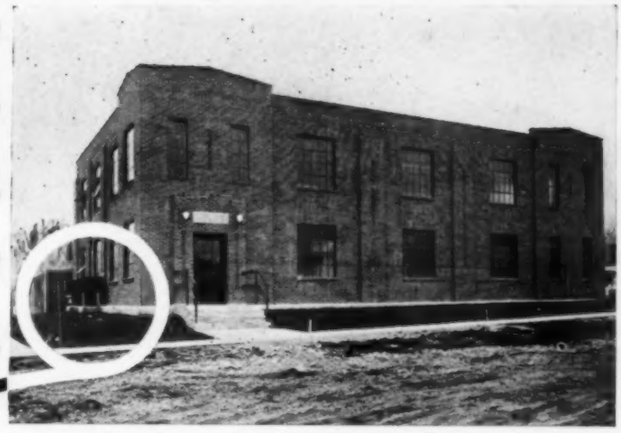
Trained lubrication engineers are available for consultation on the selection and application of Texaco Petroleum Products. Prompt deliveries assured through 2020 warehouse plants throughout the United States. The Texas Company, 135 East 42nd Street, N. Y. C.

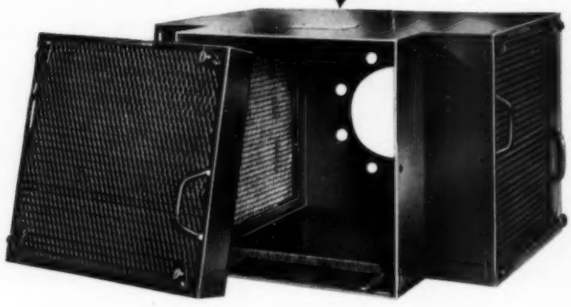
TEXACO

TEXACO LUBRICANTS FOR ALL TYPES OF DIESELS

AMERICAN OC-H FILTERS

cut maintenance and guarantee uninterrupted service in new CORNING, IOWA plant...





DIESEL engines cannot run without air, but the air must be free from dirt and grit or they will not run long. When you consider that air forms 98% of the fuel of a Diesel engine, the importance of having this air clean is evident.

Continued economical operation of their model Diesel municipal plant at Corning, Iowa, is assured by the selection of AMERICAN AIR FILTERS to protect valves, cylinders, pistons and bearings from the abrasive action of dust and grit. Thus, the cause of excessive wear and increased lubricating oil consumption is eliminated.

This installation is typical of hundreds throughout the country where American Air Filters have been protecting Diesel engines for more than fourteen years.

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AMERICAN AIR FILTERS

NO. 4 OF A SERIES

Trade School "Rookies"

Champions of Tomorrow

EACH YEAR in the field of sports, interest centers on a new batch of "rookies"; youngsters who are coming up in the ranks. Bob Feller, sensational rookie, making his debut in major league baseball, gives promise of providing this national pastime with a new champion, a new hero—who sport writers claim will outdo that old-time rookie and most famous of recent champions, Babe Ruth. Last year, Joe Di Maggio, rookie from the Pacific Coast, set the pace that gave the Yankees a World Championship. In every sport, yesterday's rookies are the champions of today.

In the professional world, the "rookies" of yesterday are the outstanding champions in the fields of law, of medicine, of science. World leaders in politics, in business, in every walk of life, were nothing more than "rookies" when they started up the ladder; youngsters who had something "on the ball"—and who quickly proved their worth when experience was added to their natural ability and the long period of preliminary training each rookie must complete.

There are thousands of rookies; but only a certain kind make champions. Seldom will there be a successful champion developed from one who lacked sound, thorough training in fundamentals, in basic principles, and in the finer details.

The future champions in the mechanical occupations of Industry, in Diesel as in other trades, will be from among those "rookies" who enter the field with the proper foundation; with the right kind of sound, basic fundamental and practical training. The function of the properly operated, efficient trade school is to take the "rookie" as raw material, and provide him with the training he needs. Such "rookies", representing a group of energetic young men, with natural mechanical ability, ambitious, willing to study hard, definitely interested in the work they have chosen for themselves — provide ideal material from which to choose the workmen needed for the specialized, technical jobs that must be filled in the rapidly growing Diesel Industry.

•

In your need for such men we are pleased to make available their services with our fullest recommendation. National Schools is endeavoring to place with the Diesel Industry young men who have been carefully trained by the most practical methods. National Schools was established in Los Angeles in 1905 and has continued without interruption under the management of its fouders, with a definite policy of honesty, sincerity and worthiness of purpose. Today, National Schools, representing a million-dollar investment, offer sound, thorough instruction courses in Diesel and Gas Engine work and Radio and Electricity.

NATIONAL SCHOOLS

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[PIONEERS OF PRACTICAL TRAINING FOR 32 YEARS]

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FRONT COVER ILLUSTRATION – The 45 ft. Dawn Cruiser *Aldoma* driven by a pair of 6-cylinder Superior Diesels rated at 100 hp. each. Photo by Rosenfeld.

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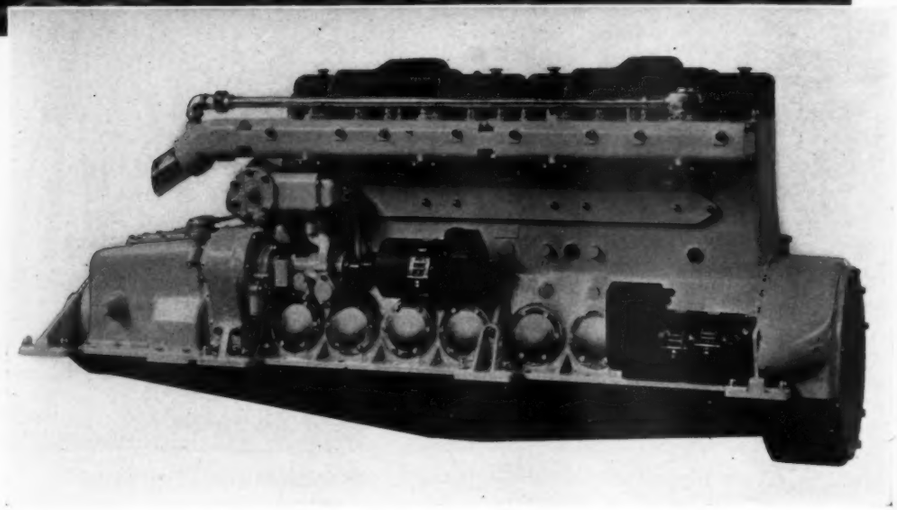


The "Seapine II," latest 53 foot Elco Diesel cruiser, on trials before being placed aboard the Diesel liner "Gripsholm" for shipment to Sweden. Inset: Her starboard engine, an eight cylinder, 150 hp. Superior. A Bendix-Holmes automatic steerer is fitted on the flying bridge.

ELCO DIESEL CRUISER FOR BALTIC SEA

WHEN the Motorship *Gripsholm* cleared New York Harbor on May first for her coronation sailing she carried the latest Elco 53 ft. cruiser of this season, the *Seapine II*. This new Diesel yacht was built to the order of Mr. T. C. Hollander of Boston, Massachusetts, who plans to use her extensively this summer on Baltic waters some fifty to seventy miles north of Stockholm. She will be returned in the fall for southern service throughout the winter season of 1937 and '38. America can well be proud of this unofficial demonstration of both boat and engines to European yachting circles. Elco cruisers are very well known throughout the United States and possessions for their sturdy construction, graceful lines and comfortable living accommodations. In the *Seapine II*, Swedish and other foreign observers will find a pleasure craft truly representative of the highest standards in American shipbuilding.

Propulsion is supplied by a pair of 150 hp. Superior Diesels of eight cylinders each. These engines give the boat a top speed of 18 miles per hour and a thoroughly conservative cruising speed of 15 miles. With over four hundred gallons of fuel oil aboard, her owner can safely rely on 55 hours of cruising without refueling or a total distance of over 800 miles if occasion should demand. This feature of marine Diesel propulsion, which has been emphasized many times in these pages, is one of the three main reasons for the selection of Diesels by yachtsmen in preference to gasoline power. The other two, of course, are the elimination of the possibility of fuel vapor explosion and the well known Diesel economy of operation. That yachtowners have been quick to appreciate these advantages is evidenced by the ever increasing number of Diesel installations, in medium sized craft.

Since the Diesel principal originated in Europe and came to American engine manufacturers from there, these latest model Superiors in the *Seapine II* should be of more than usual interest to those of the owner's guests who may

be mechanically inclined. They are symbols of American progress in the development and refinement of this type motor. Both from design and construction standpoints the Superior Model MA-8 will compare more than favorably with foreign engines of similar type and power rating.

Another point of material interest to those familiar with power cruiser operation or who contemplate the purchase or use of such a craft, is the patented Elco engine mounting. Despite the remarkable accomplishments on the part of engine manufacturers towards the elimination of vibration, there is a certain minimum point due to the inherent physical properties of all reciprocating engines where the yacht builder must share this responsibility and carry the job to completion. Elco have done just this in a most efficient manner. Engines are placed in a modified cradle which, in turn, is supported by the hull through heavy rubber mountings bonded to steel uprights on one side and the engine cradle on the other. Exhaust lines and other connections between the engine and the hull are made with flexible tubing so that there is no solid contact which can transmit vibration, however slight, to the vessel proper. The complete success of this entire arrangement is perhaps best illustrated by citing an actual and extremely sensitive test.

A glass of water placed on a table in the deck house with both engines running is not disturbed sufficiently to show the slightest ripple. Obviously, with these smooth, quiet engines and such an effective mounting, the owner cannot experience any discomfort whatsoever from vibration. Odor and noise are also conspicuous by their absence.

Ample space for comfortable living is a keynote of Elco design. The owner's stateroom opens directly onto the spacious lounging cockpit.

Left: Central grouping of controls and 360 degree vision from the flying bridge guarantee safe navigation.

In all other respects the *Seapine II* is the last word in Diesel standardized cruisers. She will afford her owner and his guests unlimited carefree cruising wherever their fancies may dictate. In addition, she will constitute concrete proof of unexcelled American craftsmanship.

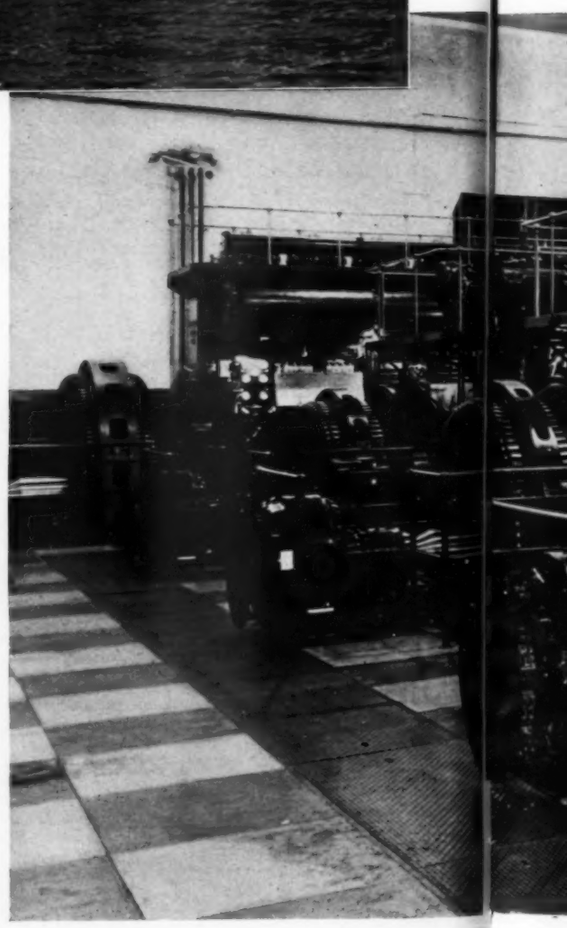
When the sun sets on Hawaii, Diesel engines supply light to the Islands.

HILO, HAWAII

By JOSEF REUTERSHAN

LITTLE does the "Malahini" (newcomer to Hawaii) realize as he approaches these enchanting islands how important a part the Diesel engine is playing in the commercial development of this Pacific paradise. Thoughts and memories of Hawaii center about unexcelled native hospitality, exquisite solar and luna rainbows, blood-red sunsets silhouetting the volcanic mountains, swimming and surf boards and a thousand other typical Island delights. Yet Diesels are everywhere, delivering dependable, economical power when there is work to be done. Here one may see Diesels of all sizes and descriptions – tractors, sugar cane loaders, trucks, locomotives, pumping stations. Enormous Diesel tugboats meet ships off shore. Fishing sampans dot the turquoise water around the tuna packing plants, all 100 per cent Diesel. Ice is artificially frozen and saki (Japanese rice wine) is brewed by means of electric power from the small, medium sized and large Diesel Electric plants throughout the Islands. The largest Diesel engine in the Territory was installed at the Hilo plant and formally assumed its load on January 28, 1937. The history of this plant which culminated in this installation is an interesting and representative story of Diesel progress in the Hawaiian Islands.

There are now four Busch-Sulzer engines directly connected to as many Allis-Chalmers generators with a total combined capacity of 4,200 bhp. Three of the Diesels are four-cycle, air injection units of 600 hp. each while the new one, rated at 2,400 hp., is a two-cycle, solid injection type. This latter eight-cylinder Diesel is similar in design and construction to the ten-cylinder, 3,000 hp. unit installed about a year ago in the Freeport, Long Island, municipal plant and described at length in the April, 1936, issue of DIESEL PROGRESS. The



two stations have passed through a somewhat similar power history in that both started with air injection Busch-Sulzer engines and, in order to keep pace with ever increasing loads, have now added the latest type solid injection units of that make.

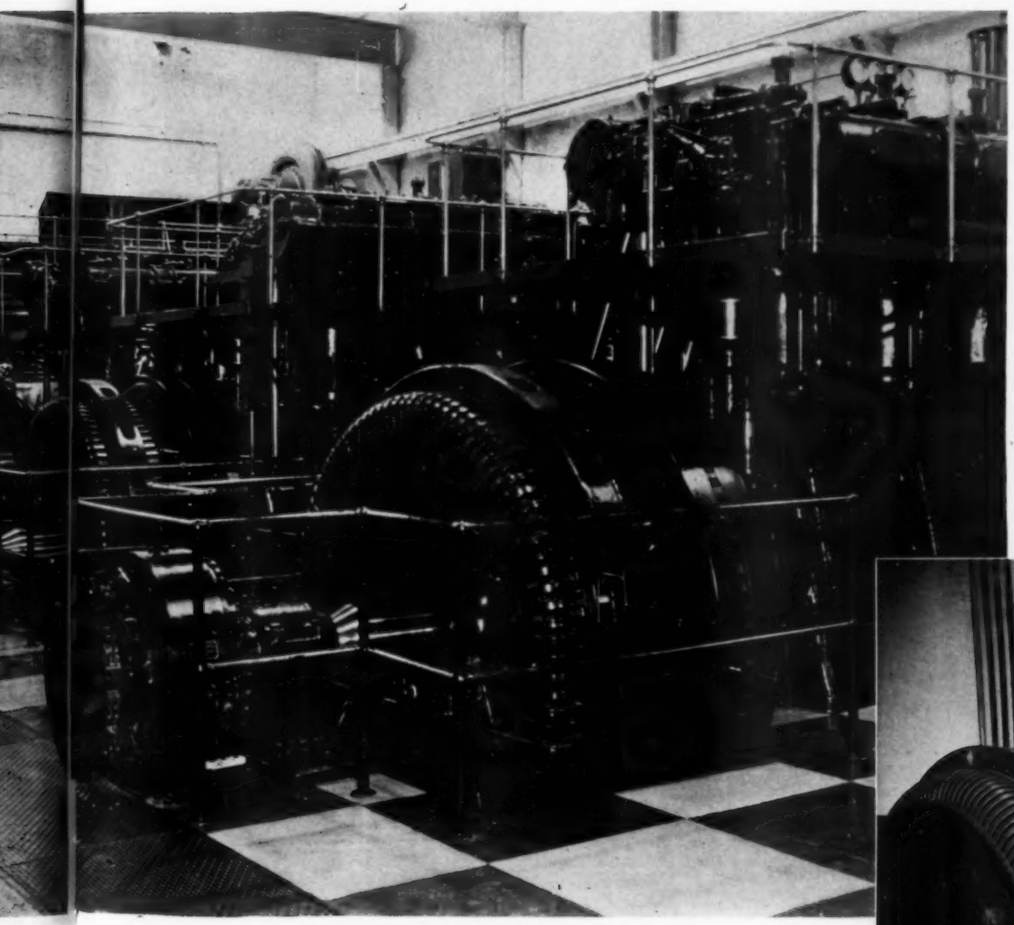
This newest model offers many distinctive features which invite attention. There is no valve gear on top of the engine. The entire control is from the engine room floor level. Fuel injection pumps, governor, starting, timing valves are all grouped at the generator end at a convenient height for the operating engineer who need never go up on the engine except to inspect the cylinder heads or parts and piping adjacent to them.

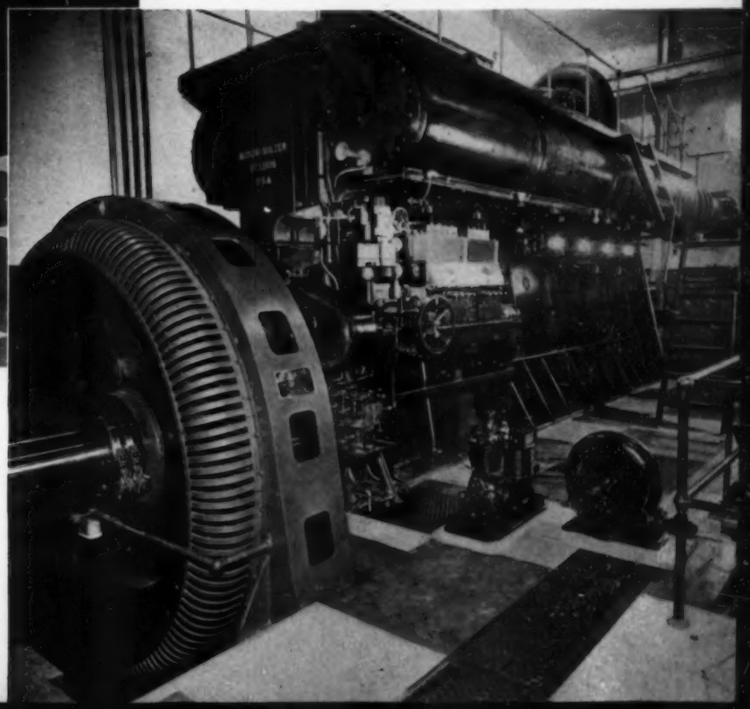
The pistons have oil-cooled, forged steel heads with the tops shaped to form the lower boundaries of the combustion chambers. The wrist pins are secured to the tops of the piston rods and provide for a bearing the full length of the pin on top. The bearings for the pin are carried in a separate casting bolted to the piston head. With this arrangement an unpierced piston skirt is possible which eliminates any possible danger of piston distortion from the wrist pin.

The solid injection fuel system is the Hesselman type. Cam operated, individual pumps are employed and control is effected by the spill by-pass system. The main, or upper, cylinder liner contains the exhaust and scavenging ports and is free to expand axially. The lower end extends into an annular open chamber through which the operator can at all times observe the piston. Any lack of proper lubrication, or other abnormal condition, is thus visually evident. The lower cylinder liner is inserted into the cyinder block below this annular chamber.

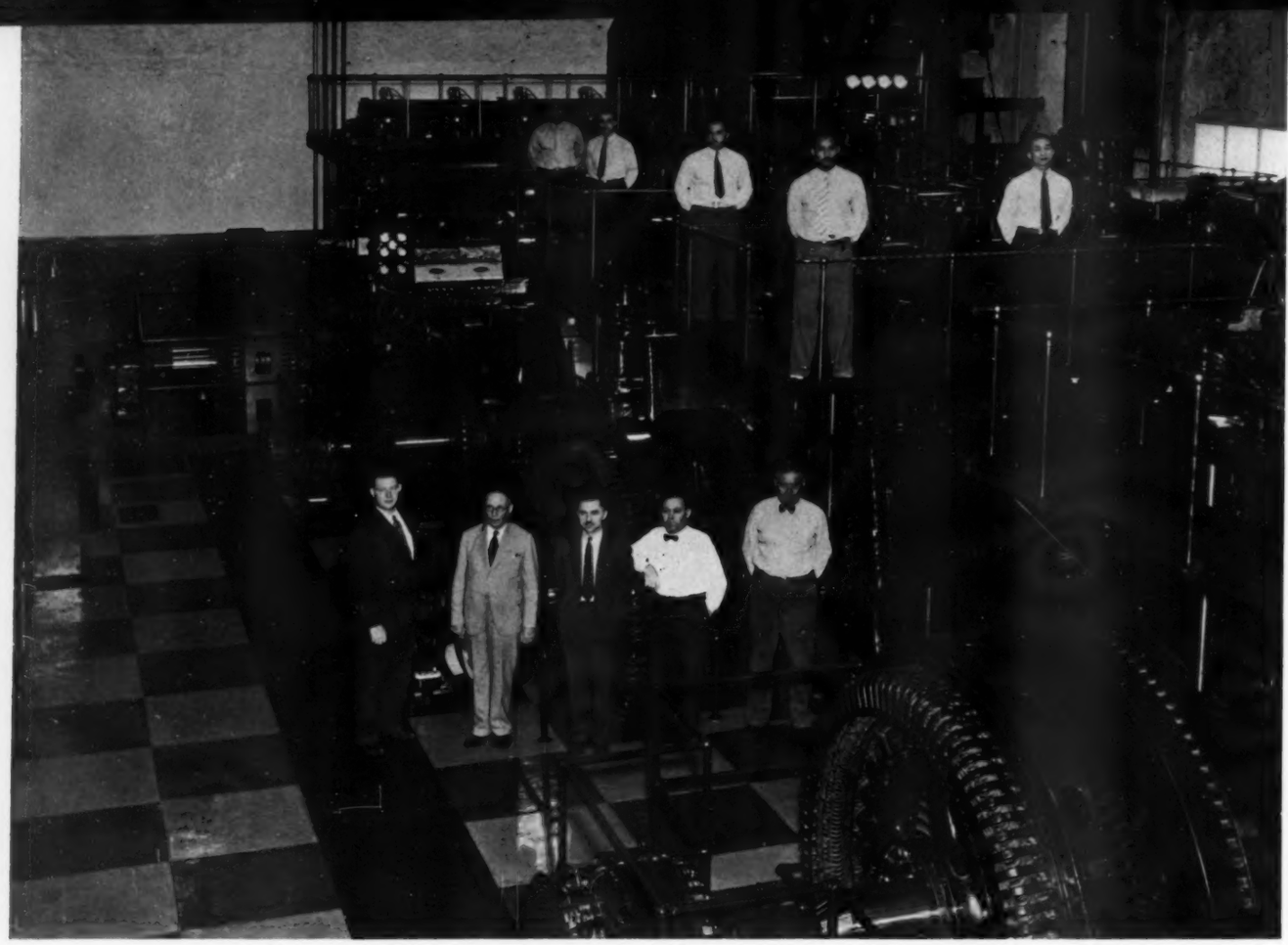
The operator is thus enabled to obtain a definite check on the condition of the cylinders and pistons and can increase or decrease the amount of cylinder lubrication or cooling water, as required. Any particular cylinder can be relieved of its load, in an emergency, by the simple expedient of cutting off the delivery of fuel at the fuel injection pump which supplies that particular cylinder. If the remainder of the cylinders are not then overloaded, the engine can be operated thus until it is expedient to take the engine out of service for careful inspection and checkup of fuel pump settings, etc., that may be causing uneven distribution of the load. This simple yet thoroughly successful feature practically eliminates the possibility of serious trouble from overloading of particular cylinders. Above and below the inspection chamber are cast iron packing rings secured by bolted glands, the upper rings scraping from the piston into sludge channels lubricating oil from the combustion chamber portion of the cylinder and the lower rings removing and draining back into the crankcase clean lubricating oil carried by the upward piston stroke. Contamination of crankcase oil by sludge or combustion gases is thus prevented. In addition, there is a Brown pyrometer installed from which readings may be taken of the exhaust gas temperature of any cylinder.

The general design of the engine follows good engineering practice and simplicity of construction has been the keynote throughout. Since this is the fourth Busch-Sulzer Diesel to be installed at the Hilo plant in less than a decade it must be obvious to the most skeptical that these engines have been providing economical, dependable power in a most satisfactory manner.





A general view of the four Busch-Sulzer Diesels and Allis-Chalmers generators with a total of 4,200 hp. at the Hilo, Hawaii plant. Right — The first and the latest generating units at Hilo.



In the foreground, left to right — Hardy Hutchinson; James Henderson, General Manager; James Otradav, Busch-Sulzer installation engineer; W. H. Sparling, Maintenance and Operation; and William Roback, Distribution and Transmission.

When the new unit was formally added to the company's generating system well over a hundred plantation managers, engineers and Island dignitaries attended the function. Great credit was given to Mr. James Henderson, Manager of the Hilo Electric Light Company (HELCO) for his far-sightedness in urging this $150,000.00 addition. Mr. Henderson, "kamaina" (old timer) in Hawaii, made some brief but pertinent remarks regarding his reasons behind the move which will bear repeating at this time. Said Mr. Henderson, "Many residents of the city of Hilo have observed the flow of the Wailuku River in the past few weeks and are wondering why our company should be required to install the largest Diesel engine in the Territory for the development of electric power in the face of such hydro-electric potentialities."

"I have had occasion to observe the flow of water in the Wailuku for the last twenty-six years," he continued, "and we have an average of two months each year when the volume of flow diminishes to a very low point. On several days in February of 1936 the water in the river was so low that the combined power of our Diesel units, our steam plant and our hydro electric equipment was only 2,400 kilowatts or 195 kilowatts less than the peak load. Therefore," he concluded, "it is to free Hilo and Hilo's power supply from the independability of the river water that this giant Diesel was added to the system."

The amazing growth of this progressive company is remarkable when one considers that less than forty years ago all of the electricity in Hilo consisted of a dozen low powered lamps furnished with current by a small water-power operated generator. This original machine belt-driven by a Pelton wheel is illustrated beside the new Diesel and the comparison in size alone is startling proof of HELCO's phenomenal growth. Today the company's lines service practically the entire Hamakua coast of Hawaii and supply electric light and power to more than fifty thousand people. Of course, one of the chief factors in Hilo's sharply rising power demand curve during the last few years has been the artificial ice industry. It was the constant increase in motor-driven compressors and circulating pumps for cooling media which helped materially to place the power demand where it is today. In addition to this special electric outlet the citizens of Hilo became "electricity conscious" with great enthusiasm as more and more power became available and requests mounted for extension of service to farther and farther outlying districts. Naturally, the more people who became accustomed to these benefits, the more there were who desired them and HELCO soon discovered that their problem was one of supply rather than sales education. Fortunately, the company has for its officials and directors men of sound business acumen and wide practical experience so the development has proceeded along sound lines. Expansion has at all times been amply justified and has been accomplished and financed in a manner consistent with consumer service as well as company welfare. The maximum advantage has been taken of natural "hydro" possibilities with the well engineered Diesel plant to supplement these for periods of peak load, low water seasons and ultimately, future expansion beyond the "hydro" facilities available. As a point of general interest, many readers will remember the city of Hilo in connection with the bombing of volcanic lava erupting from Mauna Loa in 1936. The city was saved by this ingenious experiment on the part of Army aviators.

DIESEL ENGINES

By JOHN W. ANDERSON

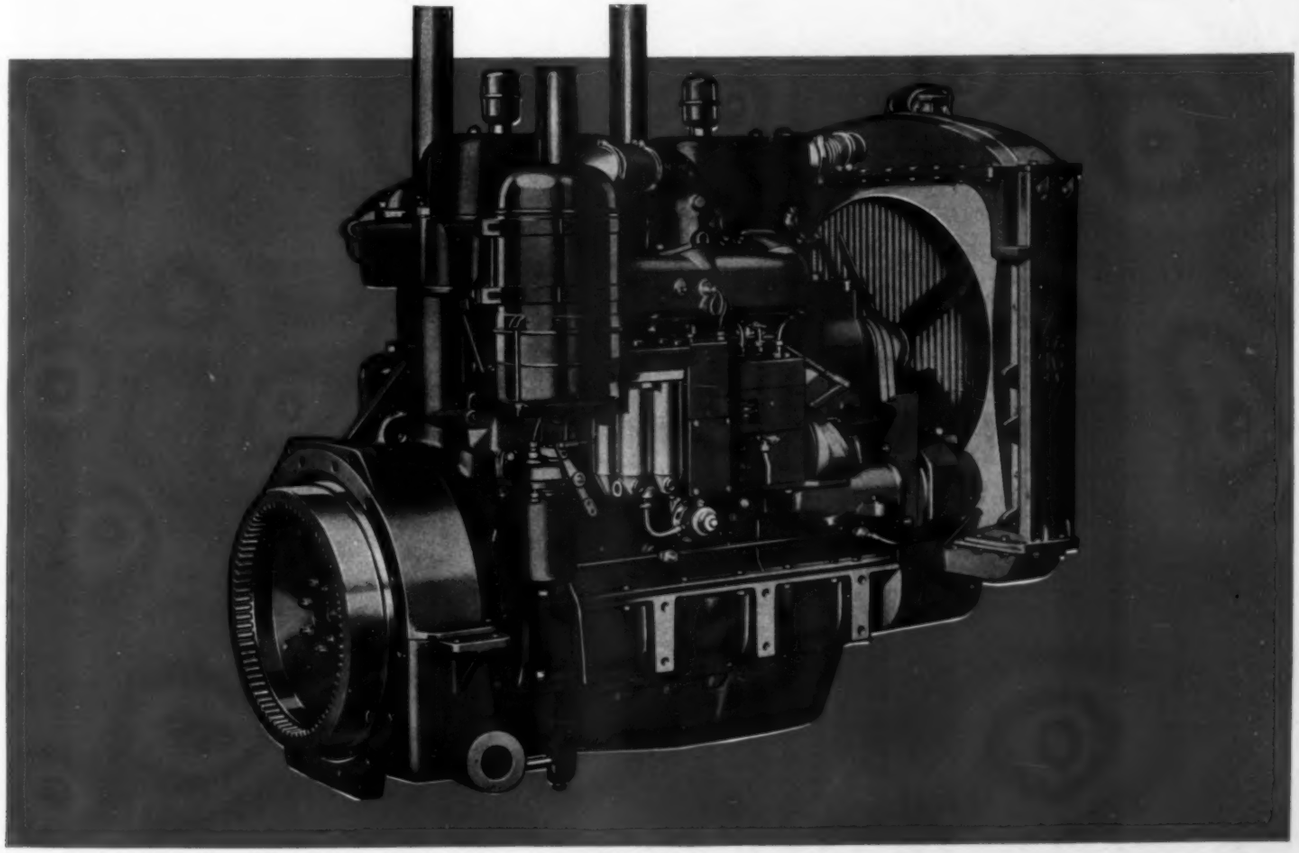
No. 4. ALLIS CHALMERS CONTROLLED IGNITION OIL ENGINES

THESE engines were especially designed for use in tractor and road patrol service, where the working days are likely to be long, the going is usually tough, the engine is exposed to extremes of temperature and operating conditions, and the care the engine gets may be none too good. Allis Chalmers felt that the best answer to these conditions was the controlled ignition oil engine which would at the same time give Diesel economy with an engine weight and speed performance comparable with that of a gasoline engine.

There are three sizes of engines—the K-O with four cylinders 5¼" by 6½", developing about 65 hp. at 1,050 rpm., the S-O with four cylinders 5¾" by 6½", developing about 80 hp. at 1,050 rpm., and the L-O with six cylinders 5¼" by 6½", developing about 105 hp. at 1,050 rpm. The L-O type is a six cylinder edition of the K-O type, and all of the engines are of the same design, so that this discussion applies equally to all.

What does the term controlled ignition oil engine mean? This is best answered by following through the cycle of engine operations. While the engine follows the four cycle sequence of cylinder events, the method and timing of the fuel injection and ignition are unique. The series of pictures show the sequence of events. First there is the intake during the down stroke of the piston. As in the gasoline engine, the governor controls the quantity of air admitted according to the load, by means of a butterfly valve in the intake pipe. During the next on compression stroke, this air is compressed. Due to the varying amounts of air admitted, the compression pressure varies with the load. At full load, it is about 160 lbs. per sq. in., and at idling speeds the compression is no more than about 25 lbs. per sq. in.

During this compression stroke at 60 degrees before top center, fuel injection begins. The fuel is atomized as it enters and is swept towards the spark plug on the opposite side of the combustion chamber. The heat of the compression and surrounding walls vaporizes part of the fuel, so that when ignition comes at 12 degrees before top center, combustion of the fuel begins promptly and spreads throughout the mixture. The quantity of fuel injected is carefully metered by the fuel injection pump



which is controlled by the vacuum in the intake manifold. Thus, regardless of the load on the engine, there is always an explosive mixture present, as in a gasoline engine. The air admitted and the fuel injected are always in the same proportion to each other.

The third stroke is the power stroke. Combustion is complete early in the stroke with a maximum combustion pressure at full load of about 420 lbs. per sq. in., and proportionately less as the load decreases. Then the gases expand until shortly before bottom center when the exhaust valve opens. The exhaust continues during the next upward piston stroke or exhaust stroke.

Under all load and speed conditions, the ignition is controlled by the ignition spark to begin at 12 degrees before top center, and combustion follows through smoothly and promptly. These engines use the same grades of fuel as Diesel engines of similar size and type, and are relatively insensitive to variations in the ignition qualities of the fuel. The engines also have good lugging ability which is a very valuable quality in tractor and road patrol service. In fact these engines develop their maximum torque at around 600 rpm., or at a little over one-half of their full rated speed.

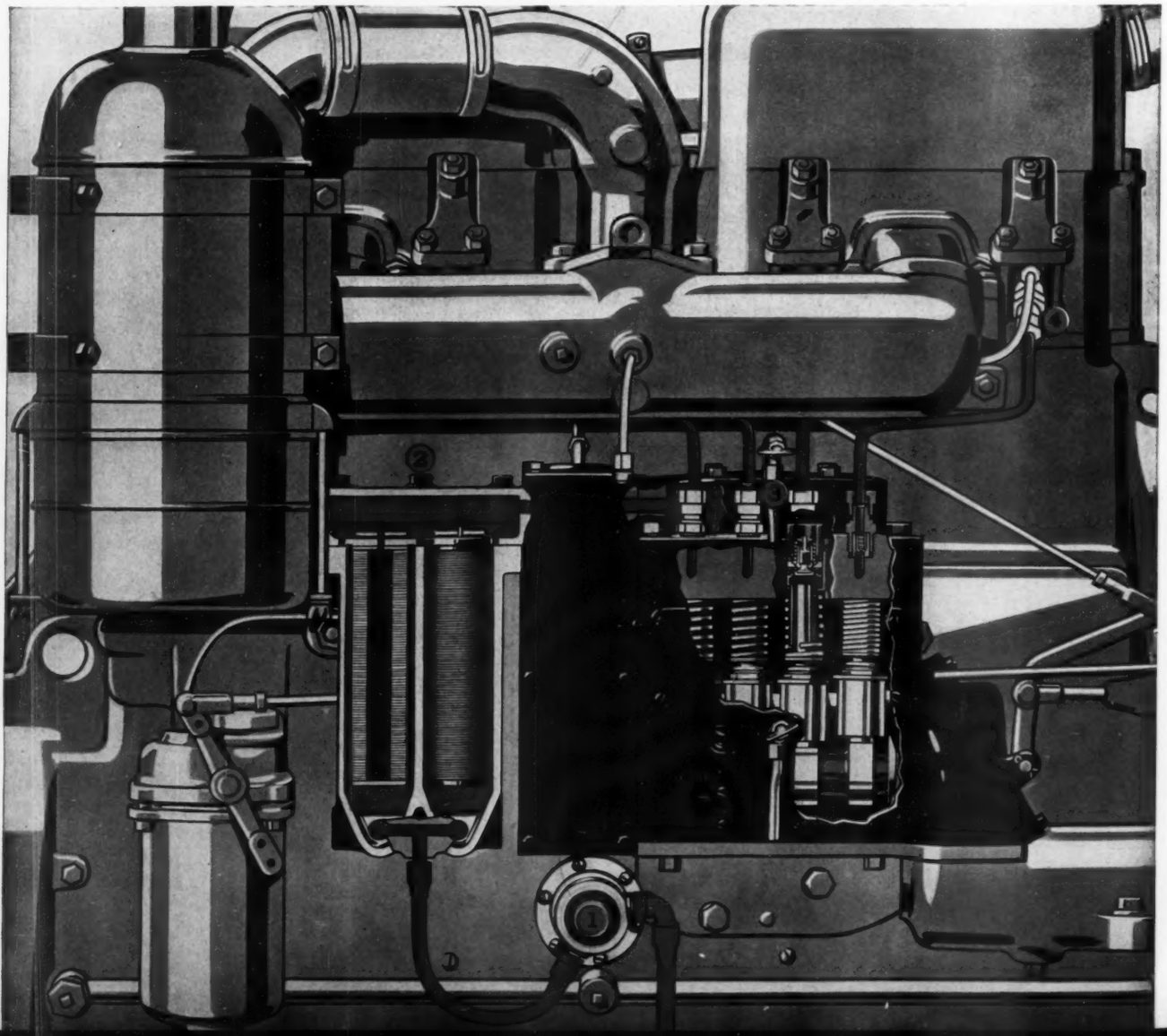
The combustion chamber and fuel injection system are shown in the illustrations. The fuel flows by gravity from the storage tank to the transfer pump 1 which delivers it at about 6 pounds pressure to the fuel filter 2 consisting of metal ribbons tightly pressed together. As the fuel passes through the filter, all foreign matter is excluded. From the filter, the fuel flows to the injection pump with one plunger for each cylinder of the engine.

Each plunger has its own suction and discharge valves in the pump, and the quantity of fuel injected is controlled by varying the stroke of the plunger. How this is done is best seen from the illustration of the plunger and its driving mechanism. The cam gives a constant length of stroke to the roller and tappet assembly, but the plunger stroke depends upon the position of the control rod. The vacuum in the intake manifold acts on a piston which in turn rotates the control rod and varies the distance the tappet assembly travels before it contacts the plunger and begins the plunger stroke.

Fuel is delivered through the discharge valve at the top of the injection pump, and through the tubing to the injector in the cylinder head. The injector has a spring loaded needle valve which lifts to admit the fuel to the tip where it is atomized and distributed throughout the air in the combustion chamber in the cylinder. A proper mixing of fuel and air is essential for prompt and complete combustion.

As the picture shows, the combustion chamber is formed by dishing the top of the piston. This keeps the cylinder head flat for a simple mechanical arrangement of the valves in the head and it provides ample room for them. Notice how the fuel injectors and spark plugs

1. Fuel transfer pump. 2. Fuel filter. 3. Fuel pump.



are both in the head but on opposite sides of the combustion chamber. Energy for the spark plugs is generated by a battery ignition system.

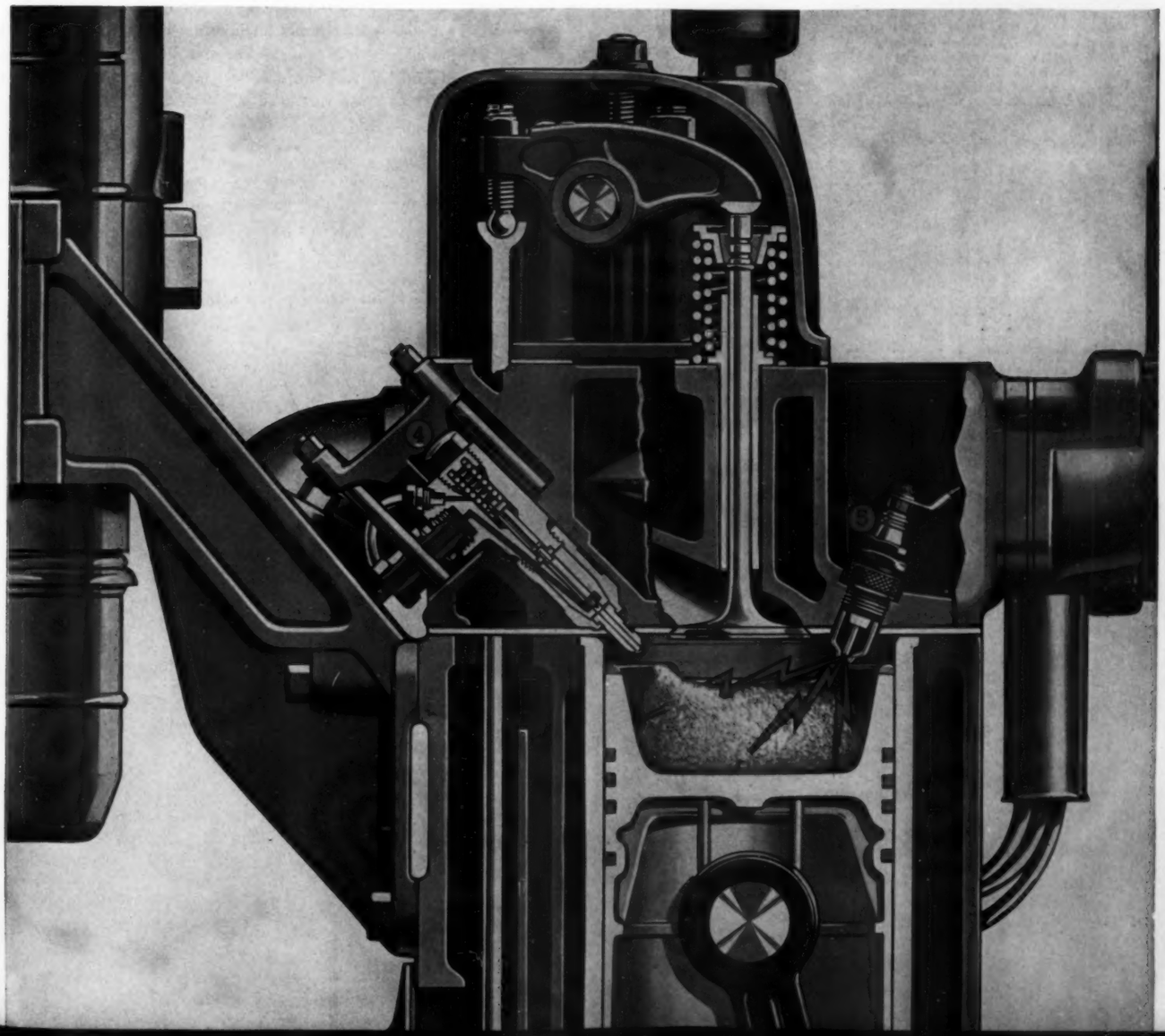
Since the combustion pressures in the cylinders are little if any higher than those in the ordinary gasoline engine, the same general mechanical construction is followed. The single piece cylinder block carries the separate wet cylinder liners as well as the main bearings for the underslung crankshaft. This block is the main structural piece of the engine to which all other parts are secured, and which holds all parts in proper alignment. The cylinders are placed in groups of two, and there is a main bearing on the crankshaft only on either side of each group. Thus the four cylinder engine has three main bearings, and the six cylinder has four main bearings.

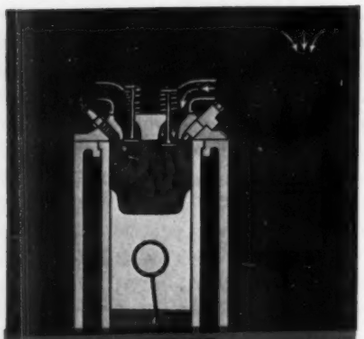
Each cylinder head casting covers two cylinders, and carries all of the valves. The intake valve seats directly against the head casting, but the exhaust valve is provided with a tungsten steel seat insert. And the exhaust valve itself has a stellite facing on the seat surface. Full advantage is taken of the space available to make both the intake and exhaust valves as large as the cylinder bore will permit. These valves are operated by push rods from the camshaft in the crankcase. The illustration shows how the camshaft is driven by the gears at one end of the engine. The valves are connected through ports in the cylinder heads to the manifolds or pipes on the sides of the engine. On the fuel injection pump side there is the intake manifold which takes the air in through the filter. Engines in the services these engines see must be carefully protected against dusty and dirty atmosphere. There is a vertical exhaust pipe for each cylinder head, that is, the exhaust valves in the cylinders in each group are next to each other and lead out through a single port in the head to the exhaust stack for that group.

A single system lubricates all parts of the engine requiring it. The oil pan bolted to the bottom of the cylinder block covers the crankcase and acts as the oil sump. While the pan is shaped to flow the oil towards the pump suction, there is in addition a suction pump which draws from the far end of the crankcase, so that the lubricating system will function perfectly regardless of the angle to which the engin may be tipped. The lubricating pressure pump (and the suction pump also) is attached to the end main bearing cap and is driven by gears from the crankshaft. The discharge is through a filter, located accessibly on the side of the engine, to the main bearings and to the valve gear. The crankshaft and connecting rods are drilled for passage of the oil to the crankpins and wrist pins.

The jacket spaces around the cylinders and in the heads are arranged for thorough cooling of all parts and the avoidance of hot spots. As is usual with engines in these services, the circulating water is cooled in a radiator. Thus there is an engine driven circulating water pump in the forward end of the cylinder jacket

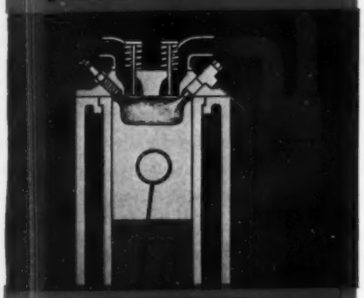
4. Fuel injector. 5. Spark plug.





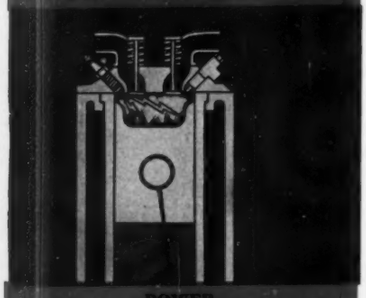
INTAKE

A measured quantity of cleaned air is drawn into the combustion chamber. The quantity is varied according to engine load by the governor.



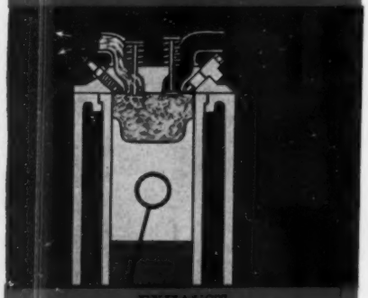
COMPRESSION

The air is next compressed to approximately 160 pounds pressure. 60° before top dead center Diesel fuel is injected and thoroughly mixed with the air.



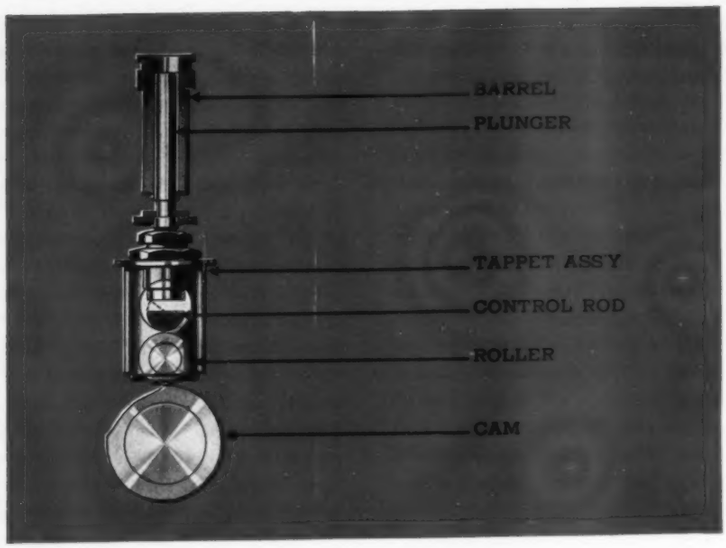
POWER

The mixture is next ignited by a spark from the magneto. Smooth, even power is delivered because of the gradual burning of the fuel charge.



EXHAUST

The exhaust valve opens and the burned gas is expelled from the cylinder in exactly the same manner as in a regular gasoline burning engine.



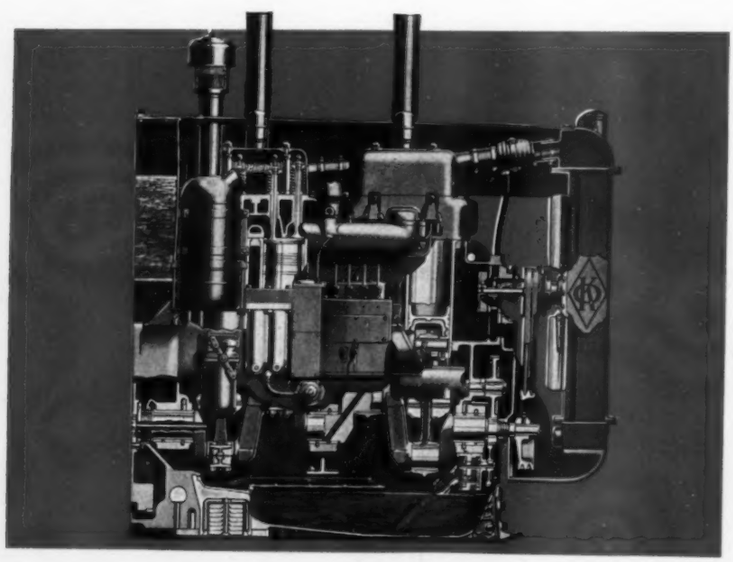
Partially cut away section of fuel pump assembly.

space and driven with a radiator fan from the engine by a V belt, and a thermostatically controlled bypass for maintaining proper jacket water temperatures under all conditions of engine operation.

The engines are easily and quickly started. Since the compression pressures are similar to those in gasoline engines, the engines may be hand cranked or started by the usual automotive type of 12 volt starting system. To give the first ignitions, there is a one quart gasoline tank and primer mounted near the intake manifold. When ready to start, one or two shots of gasoline are injected into the intake manifold. The cranking of the engine draws the gasoline into the cylinders, and the compression vaporizes it, so that when the spark comes the mixture is quickly ignited. In fact, it is likely that an injection of fuel may be mixed with the gasoline and air mixture so that the fuel will also be ignited and operation begun on fuel at once.

Many of these engines are installed where they are exposed to temperature extremes and this starting method insures starting as easily as a gasoline engine under similar conditions.

Transverse section shows lubricating oil circulation.



MAKING THE GRADE WITH DIESELS

By ARMELDA BARCLAY

FROM Los Angeles comes the story of a youth who finds the words success and Diesel synonymous. Twenty-five-year-old Othol (Red) Wells, youngest known Diesel powered truck fleet owner, began his business career at the age of twelve, when, upon the death of his father, he became the breadwinner for his mother and sister.

Working at various odd jobs to carry himself through high school, Mr. Wells managed to squeeze out of his earnings sufficient cash to purchase a somewhat decrepit Ford truck and immediately started the business of peddling river bottom gravel for use in driveways and chicken yards. This venture soon reached the extent of its possibilities when Red found that his desire for more business exceeded the demand for river gravel.

In 1930, having finished high school, eager for a chance to expand, he noticed a long, vacant building in his vicinity being occupied by the Southern Pipe & Casing Company. Wells immediately solicited their trucking and made the acquaintance of Messrs. Stumm and Stromsoe, who were also just starting a business for themselves. He was given a trial and shortly obtained additional equipment in the purchase of a second small truck.

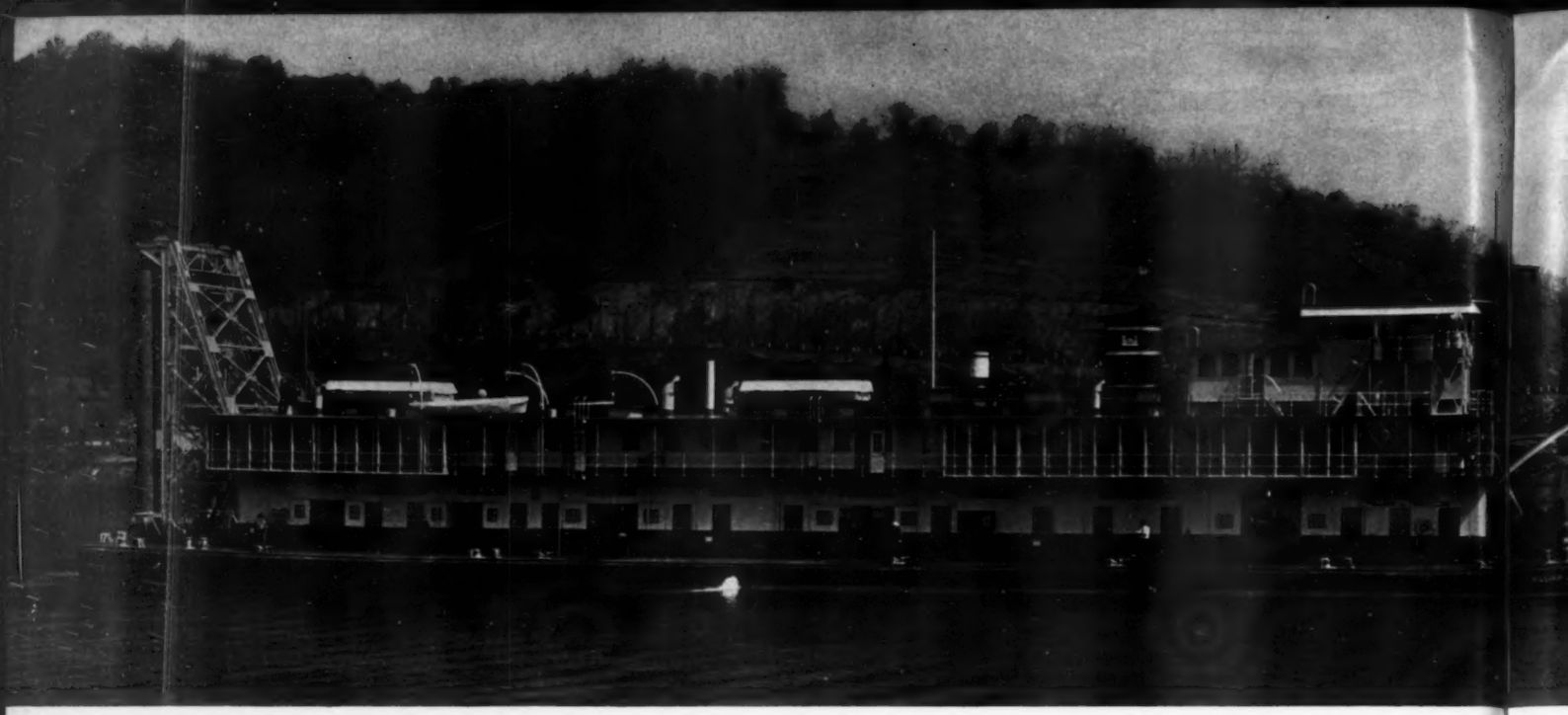
A couple of years of serious effort found the Southern Pipe & Casing Company growing into a prosperous enterprise and along with them Mr. Wells, who was now branching out into hay and cement hauling, and by 1935 he had acquired a fleet of five gasoline trucks. During these years the railroad companies were consistently lowering rates to meet those of the trucking industry to the point which made competition impossible while using gasoline trucks. The fighting spirit of the red-headed boy was not daunted. Upon close analysis of all possibilities he bought his first Diesel truck. This was a far cry from the little second-hand Ford which had paved the way for the purchases of the highest price truck on the market. A Sterling Model FC-135-H six-wheel unit, with a Cummins 125 hp. Diesel motor pulling a Freuhauf six-wheel trailer with a pay load of twenty-two tons, a gross weight of 68,000 lbs. with an investment of over $10,000. This huge vehicle is equipped with twenty-two tires on the ground, a tire replacement cost of $1,720.

The success of this modern transportation unit was quickly demonstrated, and within a year Red Wells had purchased two more Model FC-135-H Sterling Diesel trucks and Freuhauf trailers. Wells covers a very large territory and meets all road and climatic conditions. During the shipping season for hay, these Diesels have to work in the intense heat in the Imperial Valley, going into the fields to load where other trucks have been unable to go. In hauling cement from the Victorville plant of the Southwest Portland Cement Company, every truck must go over Cajon Pass in the San Bernardino mountains, where the grade averages 5 per cent for seventeen miles from the cement mill to Cajon summit, with eighteen miles of heavy down grade to reach the San Bernardino Valley. Should the destination be Northern California, it is necessary to go over the famous ridge route into the San Joaquin Valley or across the Antelope Valley into the High Sierras via Sherman grade, reaching elevations up to 10,000 feet. Southern Pipe & Casing Company s shipments reach all parts of California and the Western states, where every road difficulty is encountered and often grades up to 25 per cent are surmounted.

The Cummins 125 hp. Diesel motor has more than proved its remarkable ability to meet all trucking conditions and Wells believes in keeping his equipment to its highest point of efficiency. The Airmaze air cleaners are checked religiously to prevent unnecessary abrasive materials from entering the motor. His trucks are equipped with Cunningham dehydraters, installed between the fuel tanks and the Cuno filter to prevent any possible chance of a trace of water or acid due to condensation in the fuel tanks reaching the motor.

The Delco Remy electric starters and generators are carefully cleaned and adjusted and, although California laws require the use of eighteen separate lights on each unit, the battery of four six-volt heavy duty National batteries have thoroughly proved their worth.

In addition to his fleet of trucks, which consists of three Sterling Diesels and trailers, one International, one Reo, one Chevrolet, one Ford and two Weber four-wheel trailers, Wells has purchased a two-acre tract of land in Baldwin Park, a suburb of Los Angeles, for his office and maintenance shop. The Diesel trucks work on double shifts, averaging approximately 9,000 miles per month, and it is interesting to note that most of his drivers are his former high school classmates, which is indeed a tribute to this red-headed boy's personality and leadership.



DREDGES "WM. A. THOMPSON" AND "ROCK ISLAND"

EARLY in July, the last of the three largest cutter head suction dredges built on the inland waterways will be in use by the United States Army Engineers for river improvement, flood control and maintenance work on the Mississippi River system.

All three vessels, the *Jewett*, the *William A. Thompson* and the *Rock Island*, are self-propelled and were built for the Army Engineers by the Dravo Corporation at its shipyard at Neville Island, near Pittsburgh, at a cost of about $750,000 each, including all machinery and auxiliaries.

The *Jewett* was placed in service late in 1936, the *Thompson* was delivered during May and the *Rock Island* is scheduled for delivery in the latter part of June.

The three vessels, which incorporate many novel features of design, are indentical except that the *Jewett* is direct Diesel propelled, while the *Rock Island* and the *Thompson* are Diesel-electric propelled, and the *Jewett* has a more powerful pump. The dredges have an overall length of hull of 230 feet, a width of 48 feet, and a depth of hull of 8½ feet. The hulls are riveted, the *Jewett* being all steel, while the *Thompson* and *Rock Island* have A. M. Byers wrought iron shell plating.

The *William A. Thompson* will be assigned to the St. Paul, Minn., and the *Rock Island* to the Rock Island, Ill., Engineering District.

They are designed to meet the requirements of any channel maintenance job likely to be encountered.

The new dredges will pump the dredged material through floating pipe lines supported on pontoons for distances up to 3,000 feet with a 25 foot lift. Their operation will materially simplify backfill as well as dredging operations, due to the ease with which sand or gravel can be handled.

The *William A. Thompson*, like its sister ship, has its principal machinery on the main deck with the exception of the two 500 hp. Westinghouse propelling motors and the dredging engine and pump, which are set in wells in the hull.

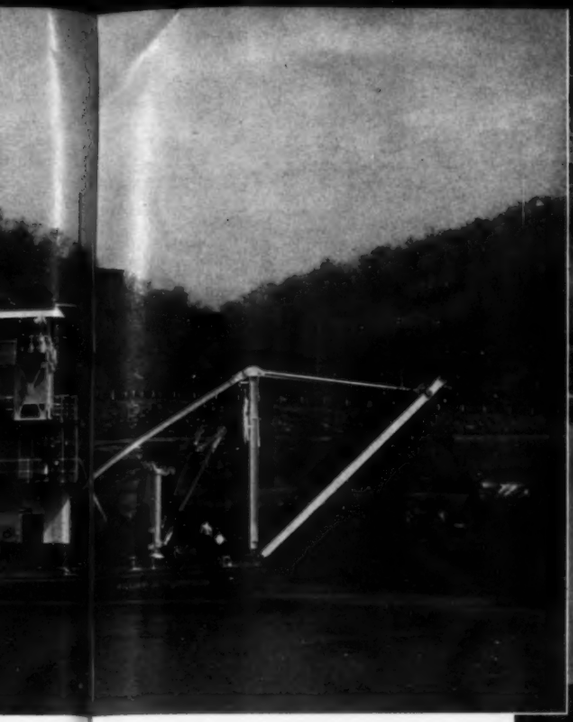
The propellers are steel of the built-up type, with a diameter of 6 feet 3 inches and a normal pitch of 4 feet 7 inches. The pitch is adjustable between the limits of four feet two inches and five feet.

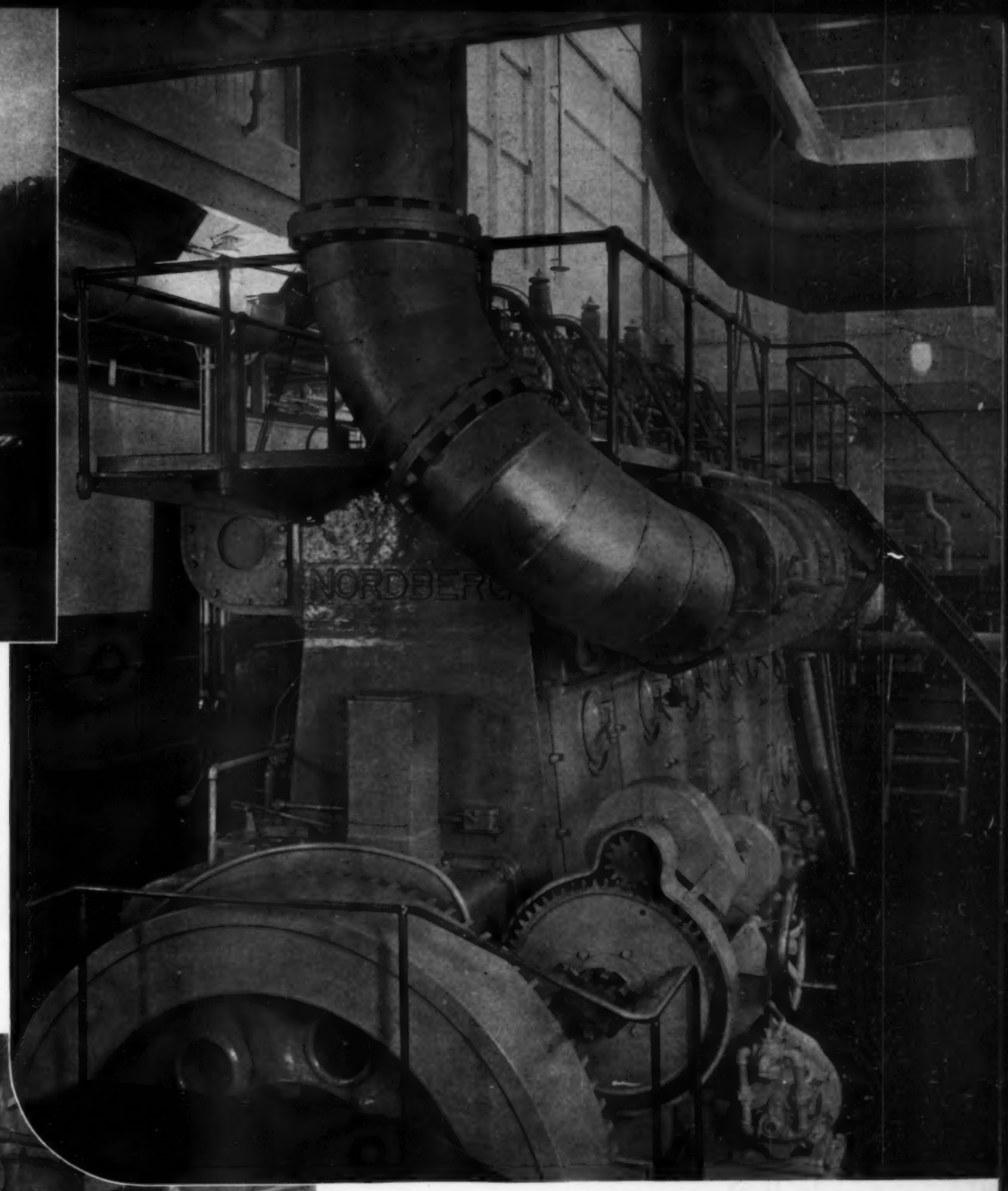
The propeller shafts are supported in cutlass rubber bearings in stern tubes and struts and each shaft is fitted with a Kingsbury thrust bearing.

The cutter head ladder dredging unit is located on the forward end of the vessel in a well or "boot jack." The inner end of the ladder is hinged to the dredge hull, while the outer end is suspended from a gallows frame mounted on the deck.

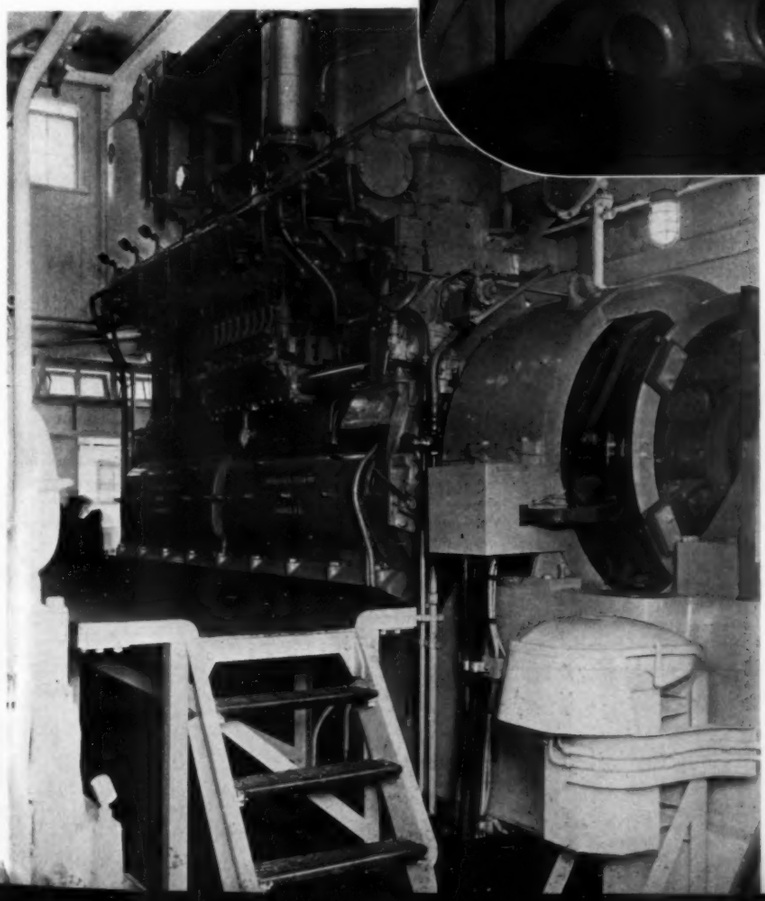
The cutter is rotated by a 300 hp. Westinghouse motor mounted directly on the dredging ladder at its upper end and driving the cutter through a Farrel-Birmingham speed reducer. In order to handle the heavy dredging ladder and its equipment, a powerful hoisting winch is located on the deck just abaft of the derrick. This is a combined unit with two other winches used for hauling the dredge from side to side to sweep the cutter head along the bottom.

A pair of spuds are suspended from a suitable framing and pass through outside spud wells at the stern of the hull. The normal operation of the dredge is to advance in the channel





On the right, the large Nordberg Diesel which is directly connected to the Ellicott pump through a Farrel flexible coupling. This unit is rated at 1,000 hp. at 250 rpm. Below: One of the two 650 hp. McIntosh & Seymour propulsion engines.



being dredged by swinging first from one spud and then the other so as to advance at a suitable rate to cover all the area with the cutter head. Due to the weight of the spuds, extremely heavy hoisting winches have been provided.

Power for the propulsion motors is provided by two McIntosh & Seymour 650 bhp. 4 cycle solid injection main generator engines, each driving a 400 kw. and a 200 kw. Westinghouse generator.

These generators provide for using Ward Leonard control for propulsion or for the operation of the large cutter head motor, the heavy duty winches and other auxiliaries.

In the generator engine room a transfer panel provides a means for connecting the main and

control circuits of the two 400 kw. generators with the propelling motors, or either one of the generators may be thrown into the cutter motor. Interlocks prevent propelling motors and the cutter motor being thrown in at the same itme.

The two Diesel engines and the generators are placed on the main deck transversely across the hull slightly abaft of the midship section of the boats. Due to the height of these engines, they extend into a casing through the upper deck. This casing also provides space for pulling engine pistons and accessibility.

The large Nordberg dredge pump engine, which is direct connected to the Ellicott dredge pump through a Farrel-Birmingham flexible coupling, is placed on the center line slightly forward and also extends into a casing through the upper deck. This six cylinder, 2 cycle, solid injection, 1,000 hp. Diesel is designed to operate at a normal speed of 230 to 250 rpm. and will be able to deliver dredged material through 3,000 feet of pipe line with a 25 foot lift. Under average conditions it will pump from 1,500 to 2,000 cubic yards of material per hour. The intake is through a 22 inch suction line of steel pipe leading straight forward to the bow, where it is connected to the suction pipe on the dredging ladder. The 20 inch discharge pipe is led aft through the hold and terminates at the stern in a swivel connection for attaching to the pontoon pipe line.

Self-contained lubricating systems are provided for the main Diesel engines. These engines are equipped with Nugent filters, Brown pyrometers, Weston tachometers, Vortex intake air mufflers and spark arrestor exhaust mufflers, United Metal flexible exhaust pipes and Viking safety controls that give warning when the lube oil pressure drops or cooling water temperature goes too high.

The engines operate with closed cooling systems. Sharples centrifuges are used throughout.

A single heat exchanger, having 1,100 square feet of cooling surface, serves all three engines. Raw water is supplied by a Cameron pump of 800 gpm. capacity with an emergency connection from the fire pump. Cooling water for the main pump engine is drawn from the fresh water tank and circulated by a 375 gpm. Cameron pump, while two similar pumps of 200 gpm. each serve the main generator engines. The 300 gpm. bilge pump serves as a standby circulator for all three engines.

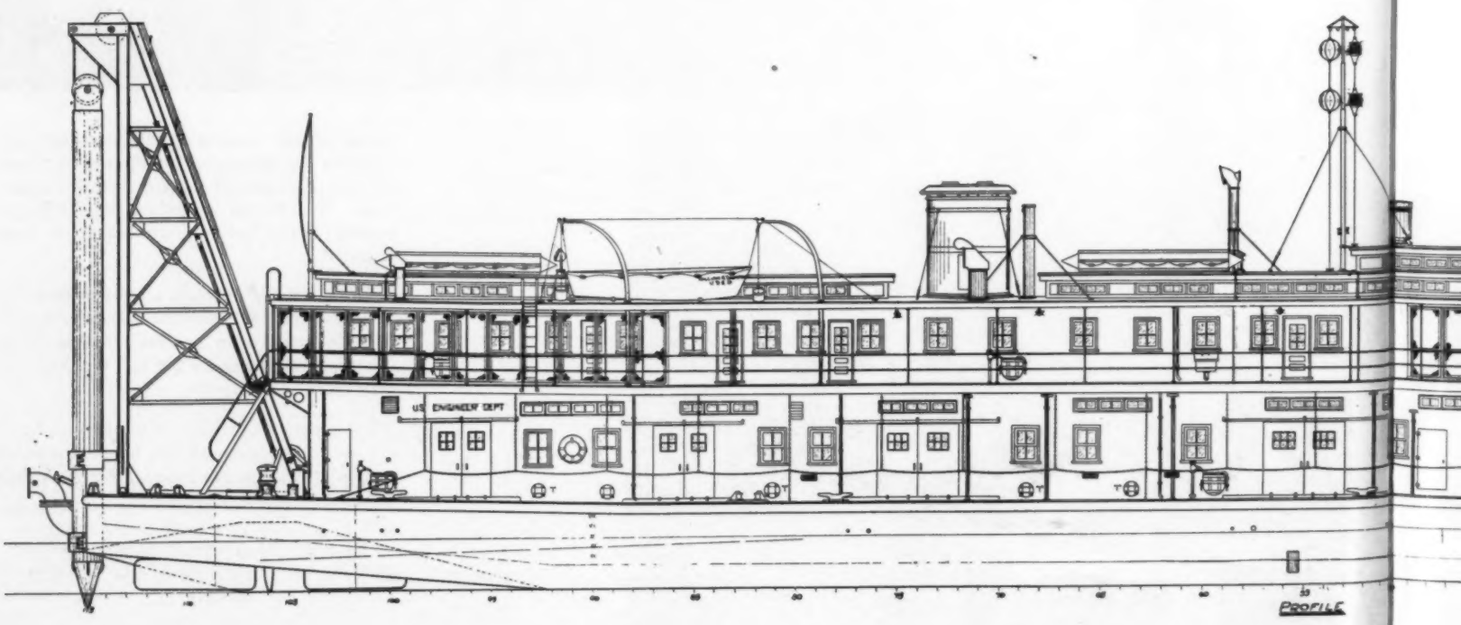
Complete machine shop facilities for repair and maintenance work are provided for the engine department. These include a lathe, shaper, power hack saw and welding outfit.

Fuel oil, lubricating oil, water storage and starting air tanks are all located in the hull. All auxiliaries are electrically operated.

The steering equipment is a new type of hydraulic gear developed by Dravo Corporation. Four rudders are provided for each dredge, two aft of the propellers and two forward of the propellers. The forward and aft sets of rudders can be operated independently, the aft set being used while the vessel is moving ahead and the forward set being used for the vessel moving astern. This gives exceptional maneuvering power.

There are two steering engines, one for the aft rudders and one for the forward rudders. Power is applied to each pair of tillers by hydraulic rams connected by linkage, the pressure at opposite ends of the ram being controlled by a special 4-way valve to which has been added a by-pass connecting pump discharge to pump suction when the 4-way valve is centered

This interior view of the operating bridge shows the efficient grouping of controls The out



operating controls and indicating instruments.
ouping of The outboard profile appears below.

and the fluid is locked in both ends of the steering ram. The control of this valve is on the follow-up system, so that the position of the steering tiller in the pilot house indicates the position of the rudder. Unless the rudder movement corresponds to the motion of the steering tiller in the pilot house the movement of the pilot house control is restricted to a small angle. A large DeLaval Imo pump furnishes power for the motion of the ram. A small DeLaval Imo pump replaces any leakage or losses due to the relief valve opening and discharging to the sump and also furnishes a minimum basic pressure for the system.

Complete control of every operation of the vessel is located in the pilot house. Propelling motor operation is regulated by the pilot house operation of Ward Leonard control by varying the field current of the 400 kw. generators. Controls of the dredging equipment are forward of the steering tillers and propulsion motor controls.

A bridge extends on each side of the pilot house the full width of the vessel. At the end of each extremity of the bridge is located a searchlight, which can be turned in any direction by remote control.

Due to the fact that a large hull has been required to support the weight of the heavy power units, without having a great draft, it has been possible to provide extremely commodious quarters for the officers and crew, which will number about 64 men. These are accommodated on the upper deck, quarters for officers being located in the forward portion of the deck house, while those of the crew are located aft.

Every effort has been made to provide the most modern facilities for the crew. The domestic water supply arrangement includes three separate systems: a drinking water supply and hot and cold sanitary fresh water.

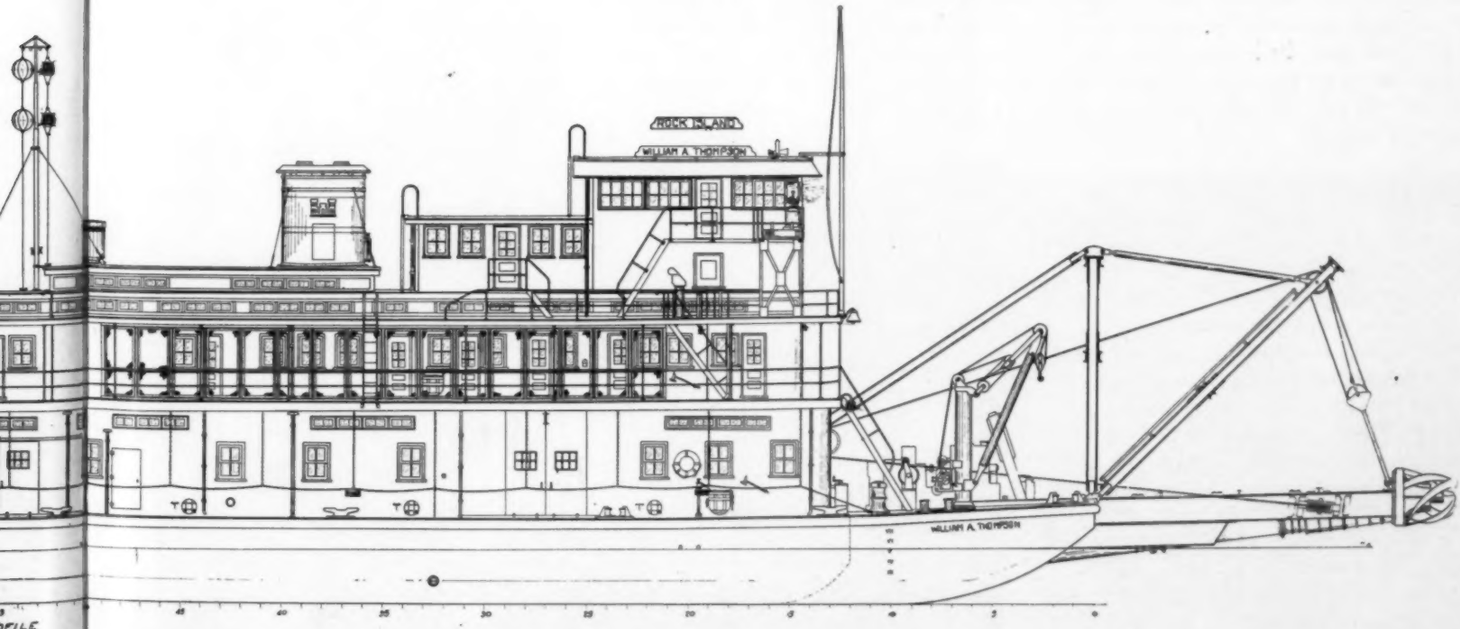
Drinking water is passed through four Hygeia Lynn stone filters with a capacity of 350 gph. each. From these, the water goes through an automatic Wallace & Tiernan chlorinator of 1,000 gph. capacity and is then discharged to two 800 gallon storage tanks. From these it is distributed to the galley, water coolers, drinking fountains and ice machine by an automatic pump with a pressure tank of 120 gallons capacity. A separate pump distributes water to the hot and cold systems and a pressure tank of 250 gallons capacity. Water for the hot water system is passed through the heating coils in the galley range and similar coils in the exhaust manifolds of the two main generator engines.

A Baker two-ton ammonia compressor with an automatic temperature control system assures constant control of the refrigerating rooms. It has a capacity of 300 pounds of ice per day.

The most modern equipment available has been provided for the galley. The installation includes such items as a potato peeler, a dough mixer and two Ray oil burning Webb ranges.

The heating system is served by an oil fired boiler and is located beside the pump engine. It is designed to burn the same type of fuel as the Diesel engines and is to be completely automatic in operation. Copper fin radiators throughout the vessel drain into a condensate tank, and an automatic pump returns the condensate to the boiler.

The three dredges are representative of the high standard of design and operating efficiency being provided by the United States Army Engineers in their river maintenance and development work.



BURLINGTON, KANSAS

By E. T. ARCHER*

WITH a population of approximately twenty-five hundred persons, the city of Burlington is located in Coffey County, Kansas. For a number of years this thriving community was dependent upon the Kansas Utilities Company for its electric energy and there was considerable argument with that organization regarding rates and service. The culmination of this dissatisfaction and unrest came in December, 1932, when the firm of E. T. Archer & Company, Consulting Engineers, was retained to investigate the power and light problem and to make recommendations from their findings regarding the feasibility of installing a municipally owned plant. The report indicated that the city could install such a plant and operate it at a profit. On June 1, 1933, an election was held, at which time a bond issue to the amount of $118,000.00 was voted for this purpose.

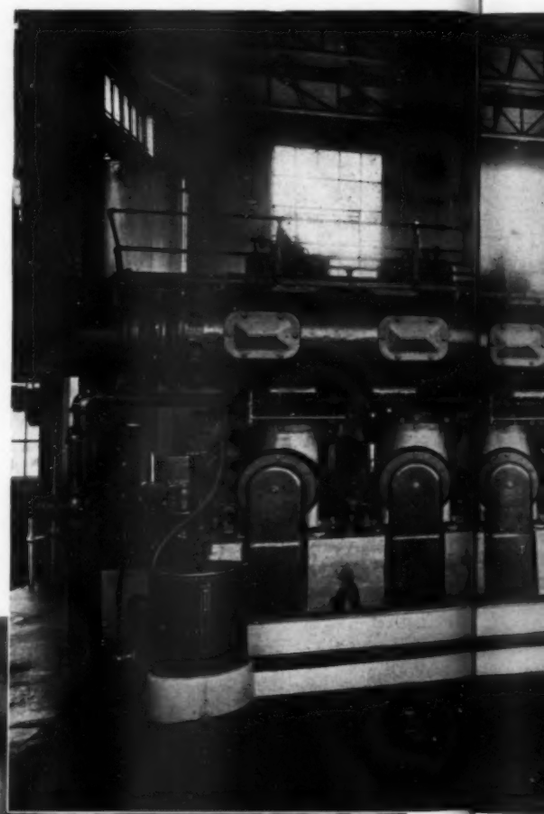
Shortly after this, when Congress established the P.W.A., application was made and granted for a federal loan to finance the new plant. In the meantime the utility company, fighting bitterly against the loss of profitable income, succeeded in having the court enjoin the city from proceeding with its municipal plant construction, using funds secured from the Federal Government. The case passed through the District Court, Circuit Court, State Supreme Court and was finally appealed to the Supreme Court of the United States. During this time the question was put to the citizens of Burlington for a second vote and once more approved by a two to one majority.

Since the government loan was still tied up through legal action, it was decided to delay no longer but to proceed with the plans on the basis of the original bond issue. Final plans and specifications were prepared and submitted for competitive bidding on August 27, 1935. The Fairbanks-Morse Construction Co. of Chicago, using Fairbanks-Morse Diesels, were awarded the contract. Specifications were based on two units totalling 750 hp., switchboard, building, distributing system and all appurtenances required for a complete plant.

Construction was started in October, 1935, and the plant was operating March 15 of the following year with two 375 hp., five cylinder Diesels directly connected to generators. Distribution was effected over the existing utility system which was purchased by the city and reconditioned. The Diesels are equipped with Woodward governors, Maxim exhaust silencers, Alnor pyrometers and American air filters. A Goulds Hydroil is installed for purifying lubricating oil. The cooling water system is the double circuit type consisting of a cooling tower and a heat exchanger with 153 square feet of tube surface. A Quincy compressor supplies starting air requirements. Two 10,000 gallon steel tanks provide ample fuel oil storage capacity. The Fairbanks-Morse Company furnished water and fuel transfer pumps and the main generators as well as the Diesel engines.

Records for the first year's operation prove very clearly the economy of Diesel-generated power. Total revenue collected for this period was $41,508.03, from which was deducted $21,916.73 for operating and distribution expenses, leaving a gross profit for the first year of $19,591.30. Deducting $13,000.00 for financial expense of bond interest and refunding of one-twentieth of the bonded debt left a cash profit of $6,591.30, but the actual net profit was $11,391.30, since $4,800.00 was paid against capital investment. The city operated Diesel plant is gaining in customers constantly and it is reliably estimated by the officials that if the present volume continues it will be possible to retire the twenty-year bond issue in less than 15 years.

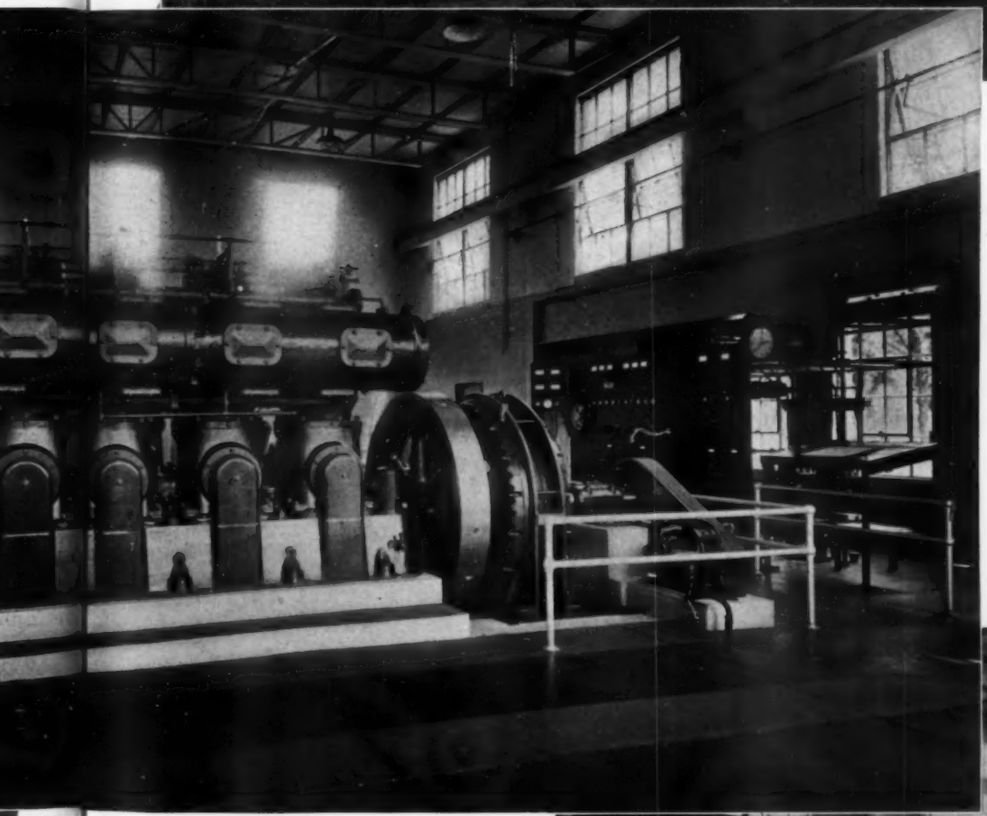
The Burlington municipal Diesel plant is typical of many others throughout the United States which are proving to be excellent sources of revenue to the progressive communities which they serve. In this particular field there are few cases where Diesels will not produce improved electric power service at materially reduced rates to the consumer.



*E. T. Archer & Co. were the consulting engineers for this installation at Burlington, Kansas.

The Burlington Diesel plant building is an architectural asset to the community. The fuel storage tanks and Maxim silencers are visible on the right.

The two interior views show clearly why the citizens are so justly proud of their new investment. Its spotless appearance reflects creditably upon the operating personnel.



Left — The remarkably clean cut appearance of the engine room main floor is due largely to the grouping of small auxiliaries along this wall, four steps below floor level. Quincy compressor in foreground.

Above — One of the new Hamburger "Ha 139" four-engined seaplanes built for Deutsche Lufthansa's trans-atlantic service. Right — Streamlining to the nth degree! An engine nacelle on a Junkers "Ju 86" transport plane.

WINGS ACROSS THE ATLANTIC

By PAUL H. WILKINSON

By now, the North Atlantic flying season is again in full swing. The recent flight of Merrill and Lambie from New York to London and back has shown that for a multi-engined airplane with modern navigation instruments, the crossing presents no great difficulties. The United States Department of Commerce, however, has called off the "Lindbergh Race" from New York to Paris on the grounds that it is too dangerous.

With a single-engined airplane, undoubtedly this is true, but with a well-equipped twin-engined plane, the risk is not so great. The ideal arrangement, of course, is a four-engined job with an adequate crew to eliminate pilot fatigue. With such a plane, equipped with Diesel engines, the risk is small indeed due to the lower fuel consumption and the absence of fire hazard.

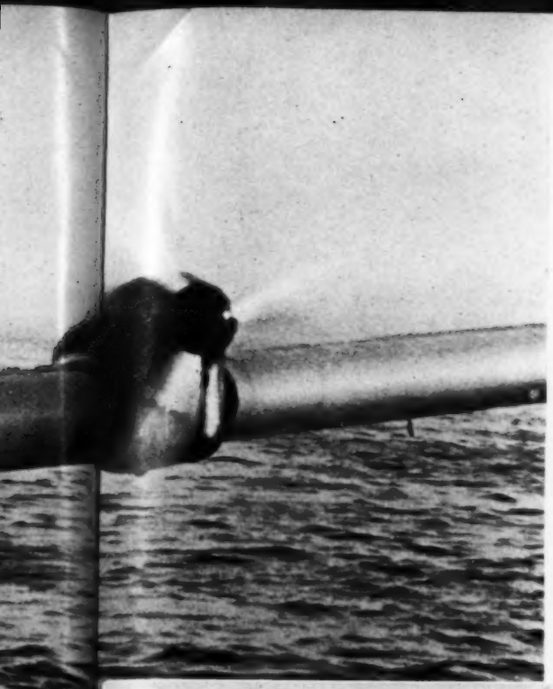
Last year, the small twin-engined Dornier *Do 18* flying boats came and went with unfailing regularity on their survey flights for Deutsche Lufthansa. This year will see the advent of much larger planes, equipped with four Diesel engines, specially built for the crossing. One of these new planes, built by Hamburger Flugzeugbau G.m.b.H., a subsidiary of the well known shipbuilding firm of Blohm and Voss of Hamburg, is shown at the head of this article.

Mounted on twin floats or pontoons, the *Ha 139* as it is called, undoubtedly will attract great attention, not only on account of its ultra-modern power plants, but also because it is designed for catapulting from floating bases anchored off New York and the Azores. It is also noteworthy in that it is the largest seaplane — as distinct from a flying boat with its single hull — which has ever been built.

The *Ha 139* has a wing span of 88 ft., and an overall length of 64 ft. At a gross weight of nearly 16 tons, it can carry enough fuel for a flight of over 3,000 miles. The four Junkers *Jumo 205* engines, with a take-off rating of 600 hp. each, give it a maximum speed of 186 mph. and a cruising speed of 155 mph. Designed for mail and freight, it carries a crew of four and has a freight compartment with a capacity of 230 cu. ft.

The particularly neat streamlining of the *Jumo 205* Diesels on the *Ha 139* is worthy of note. This is also brought out by the head-on view of the same engine on a transport plane. Streamlining the engine, and not merely rounding off the corners of an enormous disc, adds considerably to the performance of any airplane and should ultimately lead to the adoption of the in-line or veetype for all high performance aircraft.

While the frontal area of one of our air-cooled radial gasoline engines is 10.6 sq. ft., that of a liquid-cooled in-line Diesel engine of the same power is only 6.5 sq. ft. Furthermore,



the in-line engine has the advantage that its "projectile" nose does not blanket a considerable portion of the propeller blades.

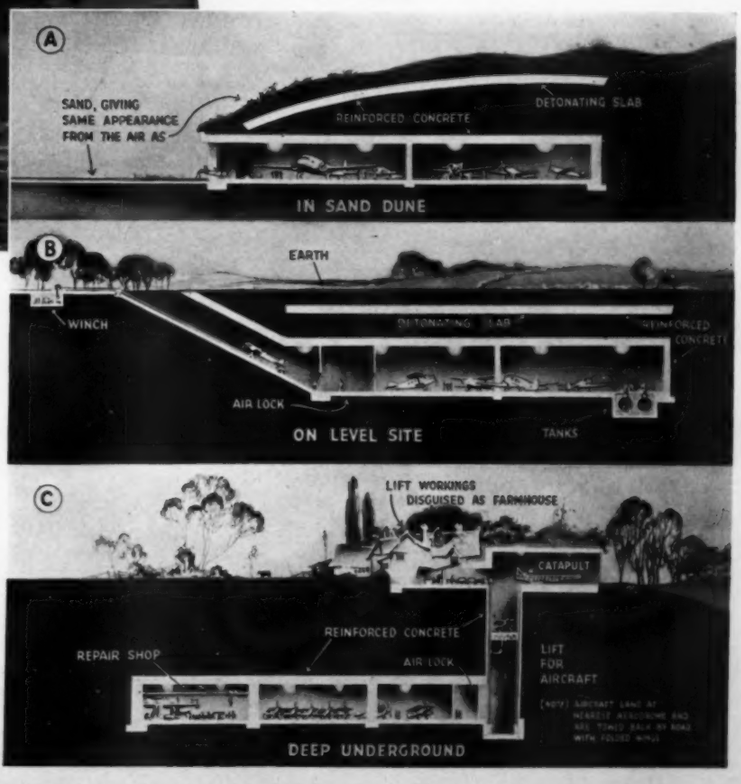
Now that the time-distance between Europe and America is about to shrink to one-fourth what it was before the advent of the transatlantic airplane, it would be well for the United States to do some serious thinking in fields other than commercial where aviation is concerned. While it is true that existing conditions in Europe make it necessary for closely packed countries to be constantly on the defensive, building up their armaments to the limit, the time may come when we too will have to do more than just flounder around with military aviation as we did in this country in 1917 and 1918. The finest aviation service in the World is useless unless it is provided with dependable ground organization, and ground organization cannot function adequately if its bases and repair shops are destroyed.

The diagrams on this page show various types of underground hangars and repair shops which are now under construction abroad. One recalls the extensive fortifications of the Maginot line along the eastern frontier of France, with its underground quarters and elaborate ventilating system to protect the occupants against gas. Incidentally, Diesel-electric generating sets, far down in the bowels of the earth, contribute their services by providing the power which is so vital for operating the electrical equipment in these fortifications.

Underground hangars such as these depend for their protection upon reinforced concrete "detonating slabs," should their whereabouts become known. Experiments have shown that to give complete protection, reinforced concrete at least 5 ft. thick is necessary if the roof is level with the surface of the ground. This can be somewhat reduced, however, depending upon the thickness of the earth above the detonating slab. One interesting method employed for launching the fighting craft contained in these hornets nests, which should prove highly effective, is by catapult and the planes are then towed back to the underground hangar from the nearby airfield on which they land.

Returning to more peaceful thoughts, let us see what is being accomplished with the aircraft Diesel in one of the oldest countries in the World – Egypt. New laurels were won there recently in the field of private ownership, when a Junkers *Ju 86*, equipped with two *Jumo 205* Diesels, took first place in the Oases Circuit Competition. Organized as an annual sporting event by the Egyptian Aero Club, the competition this year attracted 41 entries from 11 different countries. It was a handicap event, points being awarded for maximum speed and

Below – Diagram showing various types of underground hangars now being built in Europe. A – shows a design for use in coastal sand dunes. B – shows a layout for normal airports. C – shows a frontier defence station equipped with launching catapult.

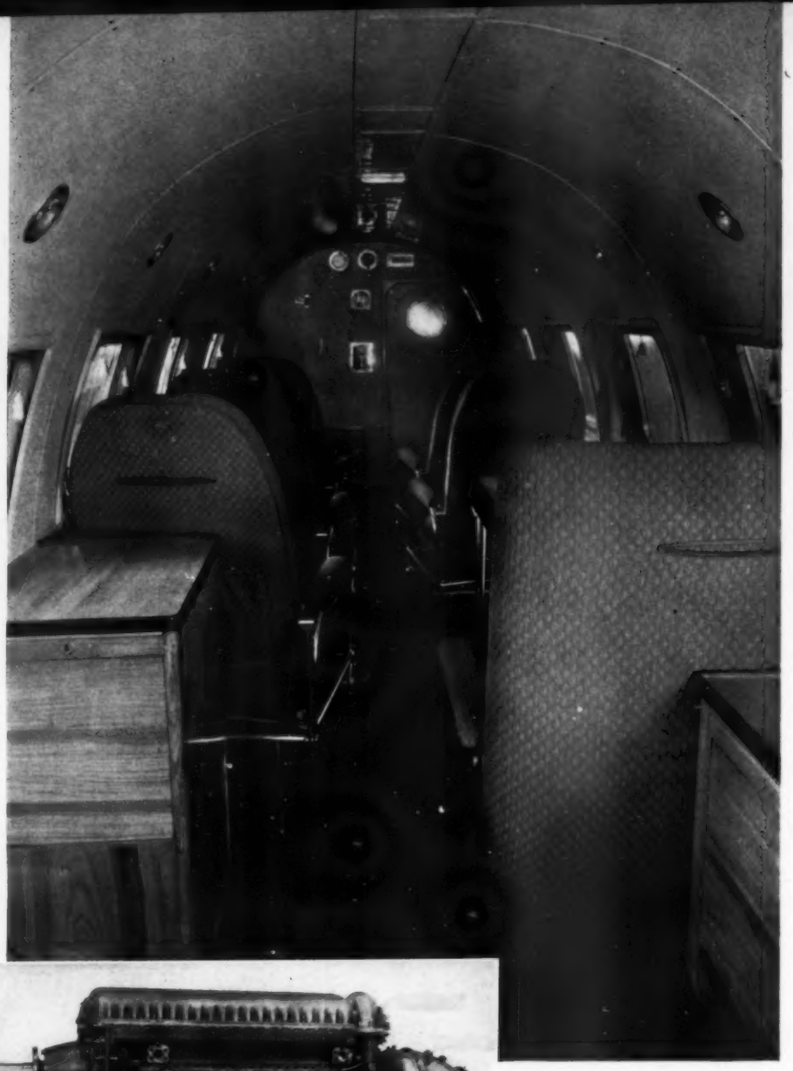


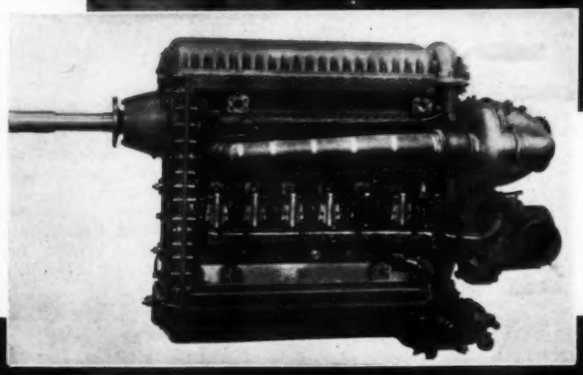
cruising speed, *low fuel consumption per passenger mile*, and the general equipment of the airplane for touring purposes.

Starting from Cairo, the course was by way of Ghobit and Hurghada on the Red Sea, then inland to Luxor and Assuan and back to Luxor, and returning by way of Oasis Junction and various other small oases in the desert, to Cairo. The winning plane covered the total distance of 1,312 miles, amid constantly changing climatic conditions and geographic difficulties, at an average speed of 180 mph.

Appropriately called "Kismet," the Diesel-engined winner was flown by Capt. Speck von Sternburg, who had as his companions Capt. von Blomberg, son of the German War Minister, Capt. von Solomon, and wireless operator Posner. Thanks to skillful piloting and the most economical fuel consumption of any plane entered, it was not difficult for the Diesel to outclass its gasoline competitors.

While the engines used on the "Kismet" were only moderately supercharged by gear-driven blowers to altitudes under 10,000 ft., remarkable results recently have been achieved with a turbo or exhaust driven supercharger on these engines in Europe. An interesting installation is shown on a Junkers *Jumo 205* Diesel, in which a gear drive is used at low altitudes and exhaust gases at high altitudes, to drive the centrifugal blower. Sea-level fuel consumption of 0.35 lbs. per hp. per hour has been maintained up to 20,000 ft. by this means, which indicates that the ceiling of the aircraft Diesel probably is about 35,000 ft. at present.





A turbo-supercharged Junkers "Jumo 205" Diesel which develops full sea-level power at 20,000 ft.

Above — Interior of Capt. Speck von Sternburg's Junkers "Ju 86" "executive model," which recently won the Oases Circuit Competition in Egypt. Below — Another view of the winning plane.

COLUMBIA QUARRY

WHEN Diesel engines are installed to fulfill power requirements the obvious conclusion is that the purchaser was influenced to the point of his decision by their economy of operation. This factor, of course, is important in every case, yet there are sometimes other considerations of almost equal magnitude financially which further serve to demonstrate the value of the Diesel engine as a power producer. This point is well illustrated by the power problem which faced the officials of the Columbia Quarry Company, St. Louis, Missouri, in July, 1936.

Up to that time the Krause, Illinois, plant of this company had drawn 25 cycle electricity from the traction line of the East St. Louis, Columbia & Waterloo Railway. The line was liquidated and the quarry was faced with the necessity of finding a new source of electric power. This was available from the local utility at a higher kilowatt hour rate and they offered only 60 cycle current, which meant the additional expense of rewinding all motors. The lowest quotation for the latter was $15,000.00, so it was not difficult to decide upon a Diesel plant in order to effect a double saving.

The main engines selected for the new plant were two Superiors, both four cycle, solid injection units with a 12½ inch bore and 15 inch stroke. The larger has eight cylinders and develops 525 hp. at 375 rpm. The other, with six cylinders, is rated at 400 hp. at the same speed. Auxiliary power is supplied by a two cylinder, 25 hp. Superior Diesel which drives a 15 kw. generator for lighting, etc., when the main engines are not operating. The auxiliary set is equipped for storage battery starting. Electrical equipment was supplied by Allis-Chalmers and includes two engine-type, three phase, 25 cycle generators of 438 and 335 kva. rating, respectively.

The cooling system consists of a Marley tower with built-in atmospheric type heat exchanger to serve both main engines and dissipate 3,500 btu. per hour. Make-up water is processed through a zeolite type softener.

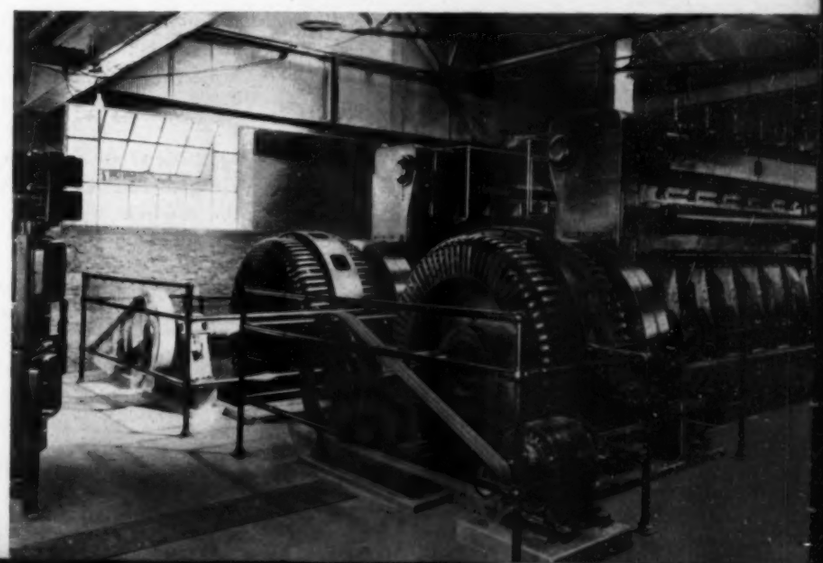
Miscellaneous plant equipment includes the following: An automatic Klaxon alarm for the protection of the main engines against low lubricating oil and cooling water supply. Alnor pyrometers mounted on the gauge board of each large engine. A Goulds Hydroil for reclaiming lubricating oil. A Curtiss two-stage starting air compressor of 19.5 cubic feet per minute capacity driven by a Wisconsin gasoline engine. A motor-driven Roper fuel oil transfer pump. Because of a rather remote location, no exhaust silencers were installed. The sound from the exhaust of these Superior Diesels has in no way proved objectionable under the circumstances.

The following data are taken from a summary of the operating log sheets from the Diesel plant of the Columbia Quarry Company over a four months' period:

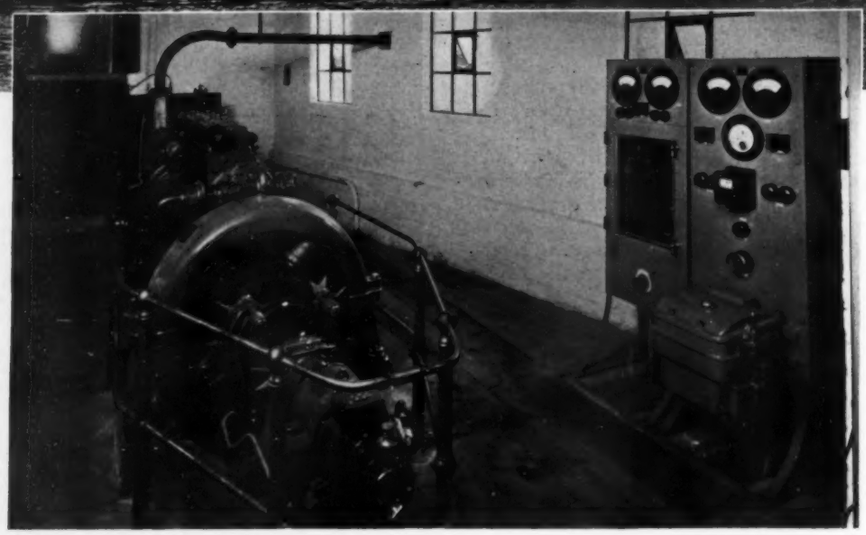
Kwh. generated	369,300
Total hours run	2,509
Average hourly kw. output	147.15
Average load factor, approximately	50%
Plant running-capacity factor	20.5%
Gallons of fuel consumed in engines	36,112
Kwh. per gallon	10.22
Gallons of fuel consumed in heating furnace	1,059
Cost of fuel for power	$1,733.29
Gallons of lube oil used by engines	264
Cost of lube oil	$127.51
Cost of maintenance, repairs and miscellaneous supplies	$85.06
*Cost of labor	$1,468.76
Total operating cost	$3,414.62
Operating cost per kwh.	.00925
Kwh. per ton of stone	2.5
Without labor item, the operating cost per kwh. is	.00527

*In justice to the Diesel plant, it should be said that no extra labor was employed to operate the power plant and at least part of the time of the operator in charge could properly be charged to care of other machinery.

The installation of these Superior Diesels saved an increase in purchased power rates plus the heavy expense of converting all electrical equipment from 25 to 60 cycle operation.



New Motorship "Delius" in the Belfast yard of Harland & Wolff, Ltd.



Paxman-Ricardo standby plant at Paddington Station of the Great Western Railway.

LONDON LETTER NO. 19

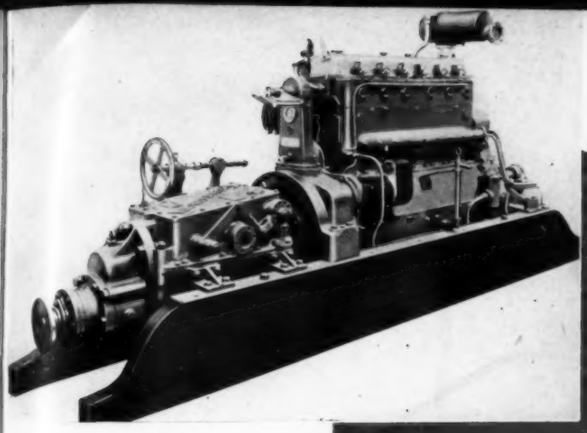
By G. R. HUTCHINSON*

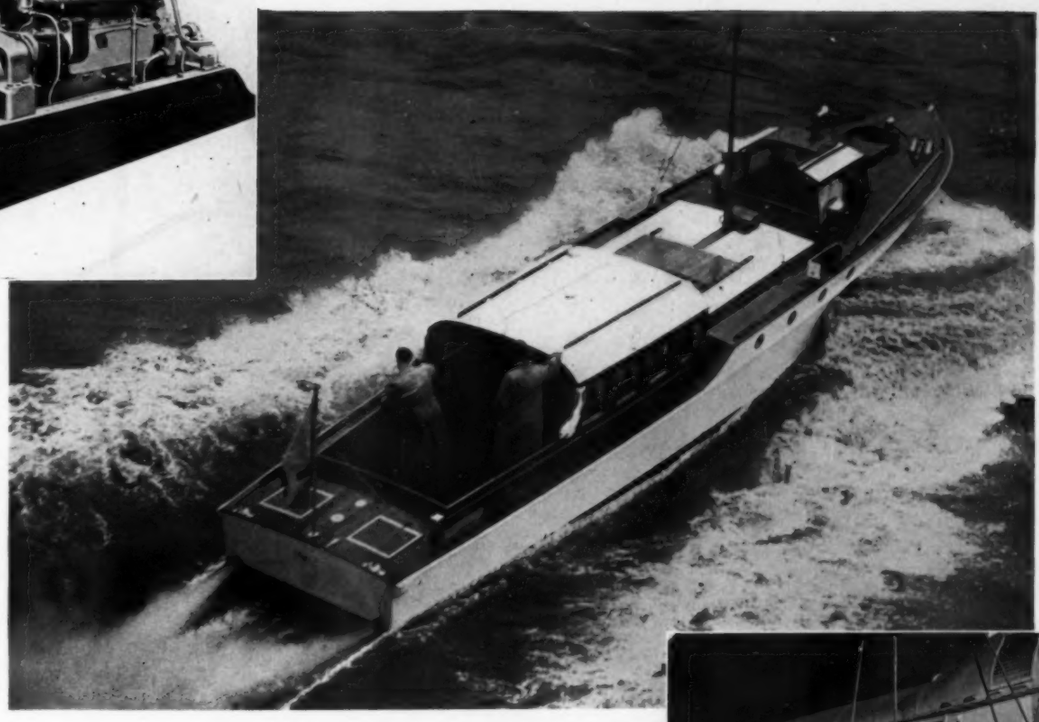
ONE of the most important motorship orders yet placed has just been announced. The N. V. Stoomvaart Mij. "Nederland" announce the placing of an order for a triple-screw motorship with the Netherlands Shipbuilding Co. of Amsterdam. The vessel will have a service speed of no less than 21 knots and is intended for the mail, passenger, and cargo service between Amsterdam and Batavia, D. E. I. The waterline length of the ship will be 630 ft., her moulded breadth 83 ft. 6 in., and her moulded depth 38 ft. 4 in.; the gross tonnage will be about 20,000 tons. There will be accommodation for 513 first and second class passengers, 148 third class passengers, and 52 fourth class passengers. The order for the main and auxiliary machinery has been placed with Sulzer Bros., Winterthur, Switzerland, and the aggregate service power of the main engines is 27,000 bhp. at 125 rpm. The engines are of the two-stroke cycle single-acting type and each will have twelve cylinders. For auxiliary services there will be no fewer than five Sulzer auxiliary engines, each of 1,800 bhp. Each of these auxiliary engines will be directly coupled to a direct-current generator and it is interesting to note that these engines are also of the crosshead type – an unusual feature for auxiliary marine Diesels.

These auxiliaries will supply power to 21 centrifugal pumps in the engine room, most of which are to be of Sulzer manufacture. The pumps are for use in connection with the forced lubrication and cooling water supply. Sulzer Bros. are also supplying the refrigeration machinery and air-conditioning plant with which the vessel will be provided. The new ship will be of striking appearance with a single-pole mast forward of the streamlined bridge and large "aerodynamic" funnel. The contract price is stated to be between 12 to 13 million guilders and when the new ship is in service it will be able to cut down the time for the run from Genoa to Batavia to 16 days, that is, a saving of 4 days. She will be ready for service in July, 1939.

Much has been heard in recent months con-

**Editor of "Gas and Oil Power" and Managing Director of the Whitehall Technical Press, Ltd.*





High speed Diesel 48-foot launch during her Thames trials. One of her two 140 hp. Thornycroft engines appears above.

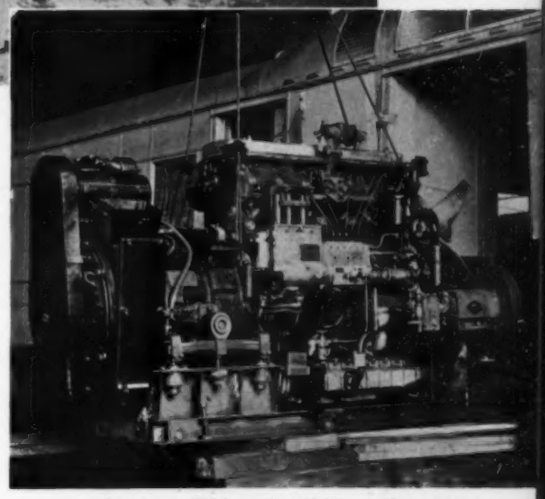
cerning the streamlining of the upper works of new vessels, the owners of motorships having set the pace in this connection. While in Europe we have had some interesting examples of this trend in design, which undoubtedly makes for more efficient propulsion in a head wind and is thus of more than publicity value, it must be conceded that we are still a long way behind the standards bold American designers have set up in the Busch-Sulzer-engined Diesel ferry *Kalakala* and the Raymond Loewe-conceived upper works of the steamship *Princess Anne.*

Along somewhat similar lines but breaking entirely new ground is an interesting feature which Harland & Wolff, Ltd., the famous Belfast shipbuilders, have just introduced in the new Lamport & Holt motorship *Delius,* now fitting out at their particularly busy shipyard. An illustration of the *Delius* at the fitting-out berth accompanies this letter and if this view is examined closely it will be seen that the bridge structure and funnel are merged into a single unit. All the deck houses of the vessel are to have a certain amount of streamlining but the idea of combining the bridge and funnel in one unit is distinctly new and not unattractive.

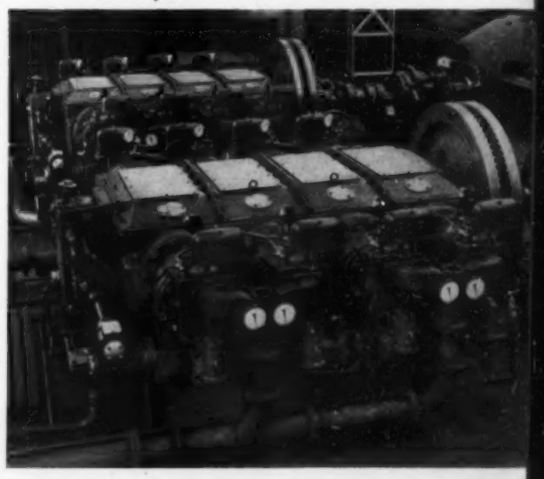
As in the case of the large Harland & Wolff-built Cunard White Star liner *Georgic* and certain other vessels, the funnel is used for accommodation purposes as well as for housing silencers. In the case of the *Delius* the captain's bedroom, the radio operator's quarters, the radio room, and other stateroom accommodation are arranged in the funnel, while the appearance of the vessel is improved by carrying the white band which is found in the Lamport & Holt funnel (blue with a white band and black top) from the funnel top through the wheelhouse and bridge superstructure. It will be interesting to see whether this new development is copied.

The main engine of the *Delius,* incidentally, is a Harland-B. & W. two-stroke cycle double-acting unit with in-built scavenging blowers and the other features associated with this now widely used design. The exhaust gases from the main engine will be passed through a Clarkson thimble-tube boiler, which can also be fired simultaneously with oil fuel should the demand for steam necessitate this.

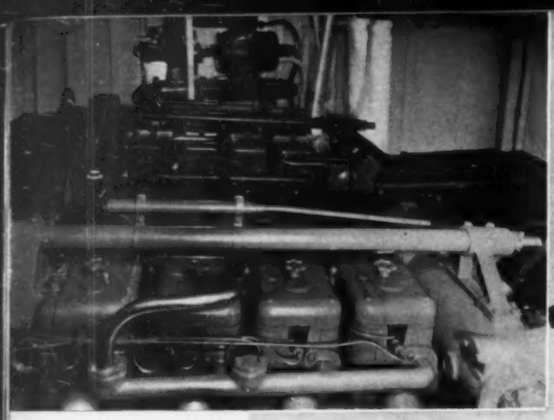
Last month we attended an interesting demonstration at the Paddington Station, London, of the Great Western Railway Company for the purpose of seeing a new emergency Diesel-generating set which the railway company has just installed in connection with light signalling apparatus. Although not the first installation of its kind on the Great Western

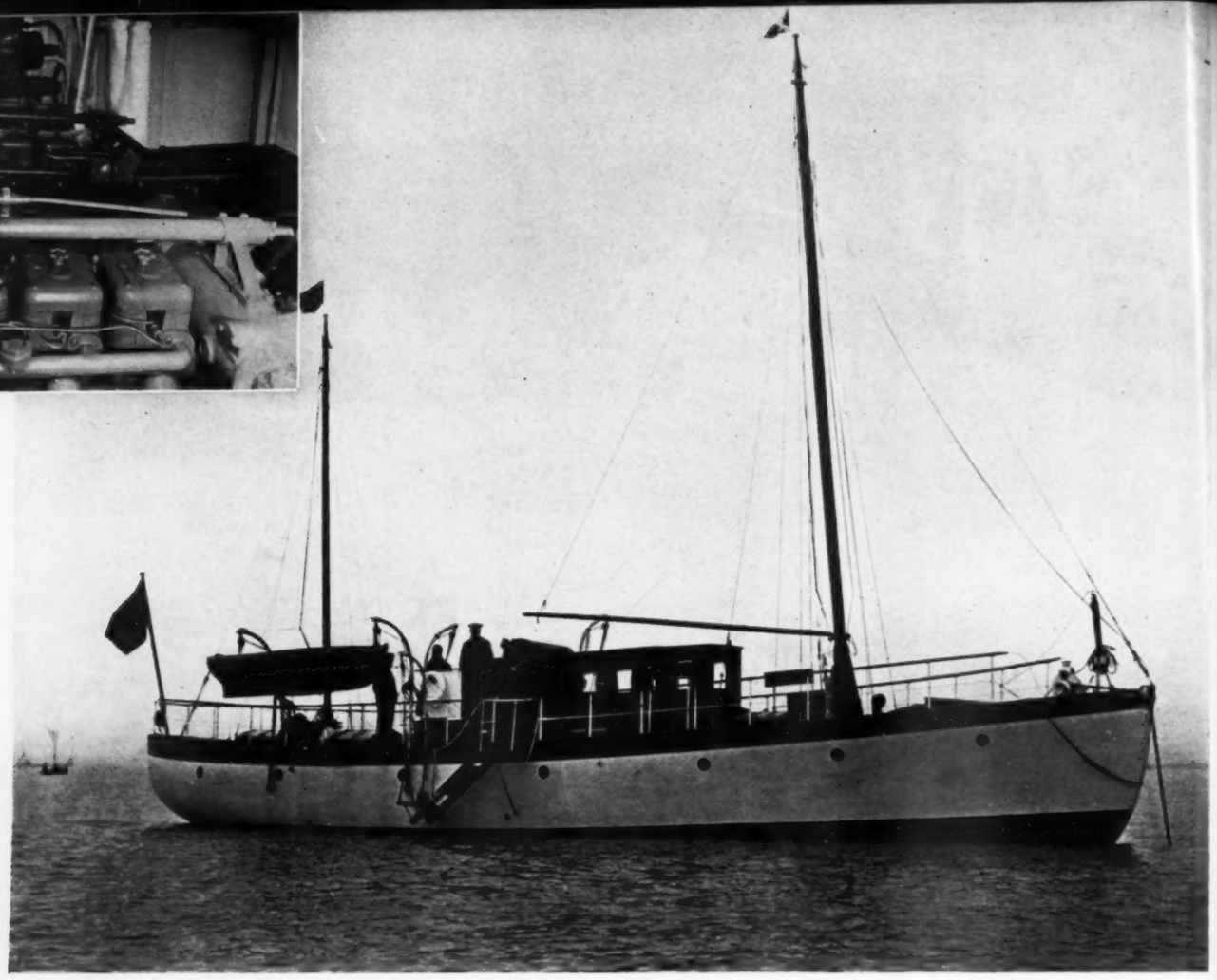


Armstrong-Whitworth 140 hp. engine-generator unit for railcar service. Six such installations have just gone to the Australian Government Railways.



Eight cylinder, 520 hp. Brush Diesels on test before going into service for the London Metropolitan Water Board. Diesels will have a major part in the modernization plans.





The sea-going auxiliary yacht, "Ladybelle," which has been converted to Diesel. She now carries two 36 hp. Ruston four cycle engines.

system we believe that this is the largest plant of its kind so far put down in this country.

The plant, which is illustrated, consists of a Davey Paxman high-speed Diesel engine rated at 157 bhp. at 1,500 rpm. It has six cylinders, 5½ in. in diameter by 7 in. stroke and employs the Ricardo aircell combustion chamber. It is mounted on an extended cast iron bedplate and is directly coupled through a pin-type flexible coupling to a 100 kw. alternator which has an Isenthal constant voltage regulator. At the opposite end of the crankshaft is a directly coupled DC starter motor-dynamo, this arrangement of starter being preferred, despite its higher cost, to the less dependable high-speed starter driving through a Bendix pinion on to the engine flywheel rim. The possibility of the Bendix gear sticking could not be overlooked and for this reason the "dynamotor" arrangement, which, in passing, is used on certain English automobiles, was adopted. Once the engine is running under its own power at normal speed the starting motor automatically functions as a dynamo and re-charges the batteries for future starting.

A Serck radiator is built on to the end of the set and has a powerful fan driven from the end of the main spindle. This radiator has an oil-cooling section through which the oil from the forced lubrication system of the engine is circulated. A thermostat is arranged in the cooling water system so that should the water temperature rise above a pre-determined maximum the engine is stopped. Furthermore, should the lubricating oil system fail an electrically-operated solonoid automatically shuts off the C. A. V.-Bosch fuel injection pumps and stops the engine.

The fuel tank has a visible level gauge and holds enough fuel for 24 hours' continuous operation, which is, of course, a very much longer period than the engine is ever likely to be called upon to operate. The set operates on the Austinlite automatic system which has been used for a considerable number of Diesel and spark ignition standby lighting plants. Although it is possible to arrange the installation, which was inspected for automatic starting immediately the bulk supply fails, in the case of the Paddington plant the Diesel-generator set is started by means of a push button from the box where the electric color light signalling is controlled. With this arrangement it is possible to bring the plant up to full load in less than 10 seconds. At the time of our visit it was not possible to see the equipment operating under load but in our presence the engine was push-button-started from cold in a remarkably short space of time.

Readers of DIESEL PROGRESS are probably aware that the Metropolitan Water Board is making extensive use of Diesel power in its present scheme of modernization and extension. Most of these engines are of the vertical four-stroke cycle airless-injection type, conforming to a fairly exacting specification as to rating, etc. It is most interesting to find, therefore, that they are to have horizontal engines in one of their new stations, although the fact has not been given any publicity. Two Brush *vis-a-vis* units are to be installed in the Shortlands station and a view of these interesting units on the test bed in the maker's works is shown. Each engine develops 520 bhp. These are the first Brush eight-cylinder engines to be built.

CHICAGO PNEUMATIC ANNOUNCES NEW DIESEL

By JOHN W. ANDERSON

Side and end views of this new Chicago Pneumatic Diesel engine show clearly its clean cut external appearance. The gauge board carries an Alnor exhaust temperature pyrometer as standard equipment.

ANNOUNCEMENT of a new Diesel engine has just been made by the Chicago Pneumatic Tool Co., and it is an interesting example of the current trends in Diesel engine design. Fully enclosed, full pressure lubricated, and while it is in the medium speed class and intended for the arduous duties of stationary service it is designed to be adaptable to other services also and to a wide variety of installation and operating conditions.

The photos show the general appearance of the engine. Cylinders are 8 in. by 10½ in., and the normal rating is 87½ hp. at 720 rpm. for continuous duty, with the usual 10 per cent overload capacity available. For intermittent periods, the engine can be operated up to 900 rpm. with a corresponding increase in power available. This engine is built in 2, 3, 4, 6 and 8 cylinders, giving a normal power range of from 75 to 300 hp., or from 50 to 200 kw., at 720 rpm.

Fuel injection equipment is from Bosch. The injection pumps, one opposite each cylinder, are driven from the camshaft which is located along the side of the engine. Injection pumps and push rods are enclosed but quickly and easily accessible by removing the covers along the side of the engine. The fuel injection valve in the center of each cylinder head has a multi-hole nozzle, and the combustion chamber is formed in the top of the piston. It has the familiar shape of the flattened Mexican hat.

Several items among the many mechanical design features are interesting. The crankshaft is a large one — journals are 5¾" diameter and the pins are 5" diameter. The working pistons are of cast iron. A Pickering governor is used, and the type varies with the application of the engine. A type to suit any variety of service conditions is available. Note the marine type of base or bedplate with the flanges along the sides for fastening to the foundation. There are pads provided for an engine driven attached Roots-Connersville type blower for super-charging, should the installation conditions require it. And there are pads for an engine driven bilge pump should it be a marine installation.

The lubrication system is entirely self-contained within the engine. The lower part of the base is used as the sump, and there is the attached pressure pump and filter. Valve gear parts as well as the crankshaft and wrist pin bearings are cared for by the one force feed system. Even though this requires the complete enclosure of all of the parts, the removal of the top and side covers, or the crankcase doors, makes every part of the engine immediately accessible.

Usually the circulating pump for the cooling water would not be supplied, but provision is made for attaching one when it is needed.

As the pictures indicate, all of the controls and instruments and gauges are concentrated at the operator's station at one end of the engine. It adds to the convenience.

The flywheel shown in the illustrations is the one used during the shop tests of the new engine, but of course this item always varies according to the service requirements.

Like other Chicago Pneumatic engines, this one is also convertible into a gas engine, and in such cases the cylinders are increased 1" in diameter to become 9" bore by 10½" stroke. This is permissible due to the lower maximum combustion pressures for the gas operation, and it keeps the rated mep. down below 70 lb. per sq. in. The Diesel engine runs somewhat higher than this.

The design of this engine represents the pooling of considerable experience and is the culmination of quite a wide background of development work.

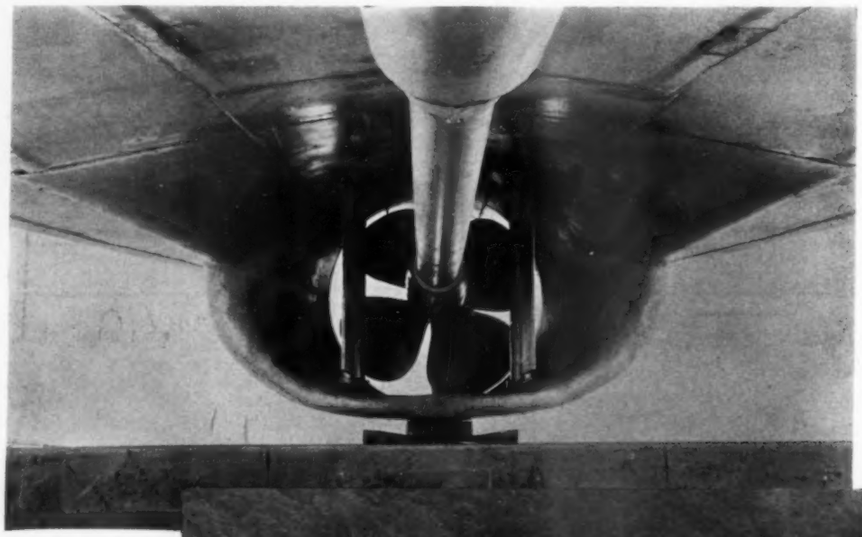
KORT NOZZLE TEST ON M.S. "PIONEER"

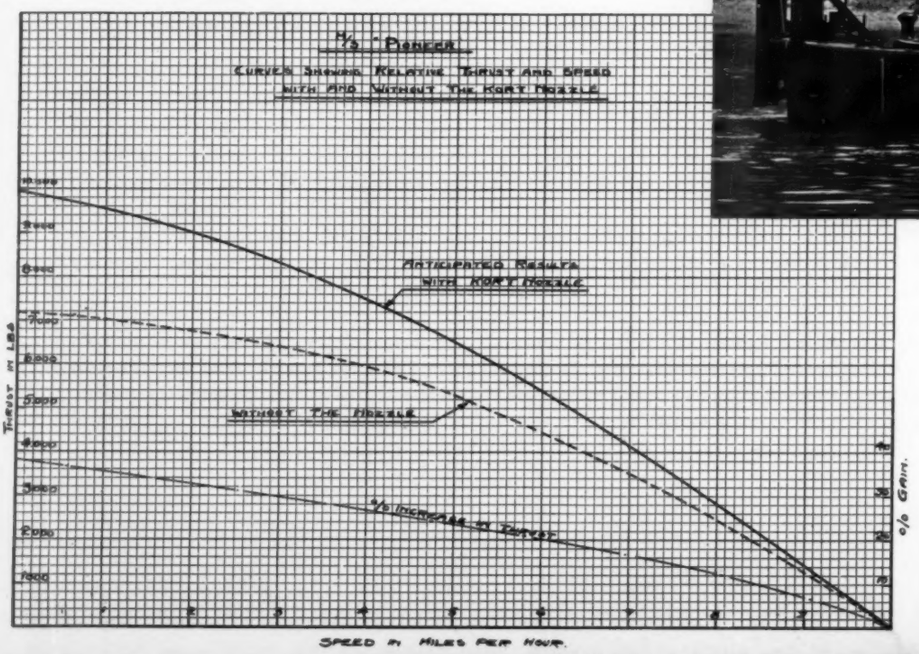
By GEORGE SNYDER

AN interesting demonstration was made at the Neville Island Plant of the Dravo Corporation on Thursday, May 13th, at which time a gathering of representative marine men from both the seaboard and the inland rivers were present. The assemblage was for the purpose of witnessing a test of the Kort nozzle, which has recently been fitted to the Dravo Corporation, 250 hp., single screw, tunnel type towboat *Pioneer*. The *Pioneer* is an all steel boat having full modeled bow and tunnel stern. The hull is 93 ft. long, 21 ft. wide and 9 ft. 6 in. deep with an operating draft of 4 ft. 3 in. The engine is direct connected to the propeller and has an air operated remote control stand conveniently located in the pilot house from which point the pilot makes all engine maneuvers.

The demonstration included the boat running free over a measured mile, and handling various fleets of barges, using the Dravo dynamometer barge as a medium for measuring power developed. After the river trials the hull was taken out on the Marine Ways so that the visitors could inspect the nozzle and rudder system. In making comparisons of this boat and her ability before and after the fitting of the Kort nozzle, it was emphasized that in using the *Pioneer* as a trial and demonstrating unit the most severe task possible was imposed upon the Kort nozzle.

The original *Pioneer* had an arrangement of skegs which were a continuation of the tunnel form to the centerline of the wheel and from there to the base line of the boat were vertical sided. Twin rudders were hung on both the forward and after end of these skegs and interconnected so as to approximately balance. The net result of this device was the complete elimination of side thrust, the boat having a backing power equal to 80 per cent of its going




M/S "Pioneer"
Curves Showing Relative Thrust and Speed With and Without the Kort Nozzle
Anticipated Results with Kort Nozzle
Without the Nozzle
% Increase in Thrust
Thrust in Lbs
% Gain.
Speed in Miles per Hour.

This well known Diesel river tug showed improved performance after the addition of her Kort nozzle illustrated above and below.

ahead power and a rudder power in each direction equal to 50 per cent of the thrust in that direction. The Kort nozzle is a development beyond the twin skeg arrangement originally adopted. It is a structural steel ring of substantial proportions and ample strength, which in addition to eliminating the side crawl, controls the amount and velocity of water drawn through the propeller.

Computations from the tests indicate results obtainable from the Kort nozzle to be as shown on the accompanying curve. The curve of results obtained without the nozzle has been developed throughout its length by means of the test barge. An examination of these two curves will show that the vessel has gained approximately 37 per cent at bollard test. This gain gradually decreases as the slip decreases although there is an anticipated 25 per cent gain at 4½ miles, which is the normal towing speed for this vessel. In service, the towing speed seldom exceeds 5½ miles an hour and is seldom less than 4 miles an hour. The additional effective thrust at speeds below the four miles provides quicker acceleration in getting away from a landing or a lock.

The *Pioneer* has already made one long distance trial tow with the Kort nozzle, and the captain has reported a very satisfactory improvement in performance. The results obtained have been sufficient to warrant the installation of Kort nozzles to two additional boats of the same hull dimensions but with additional power. The new boats will be powered with a six-cylinder 12½" x 18" Nelseco engine, whereas the *Pioneer* is fitted with a six-cylinder 11¾" x 15" Nelseco.

Dravo recently obtained the exclusive rights to the Kort nozzle in the United States, with the exception of the Pacific coast.

The nozzle, developed by Mr. L. Kort of Germany, is a device to produce additional effective thrust from a screw propeller without any increase in the power requirements for driving the propeller. It consists of a steel structure attached to the hull of the vessel and surrounding the propeller which forms a cylindrical tube immediately around the wheel. The forward nozzle body has a broad airfoil section flaring open from the propeller, with the external portion of the nozzle body tapering to meet the inner tube aft of the propeller.

The duty of the nozzle is to control the direction and the velocity of the water driven by the propeller in such a way that maximum forward thrust is obtained from the column of water driven out by the wheel.

The device reaches its greatest efficiency in cases where there is a large amount of slip. The added thrust provided is not important in the case of a free running vessel in calm weather, but the curve of its effectiveness rises steadily as the amount of slip increases, as in the case of towboats, tugs, trawlers, vessels traveling in restricted waters such as canals, and deep sea vessels working against head winds or heavy seas.

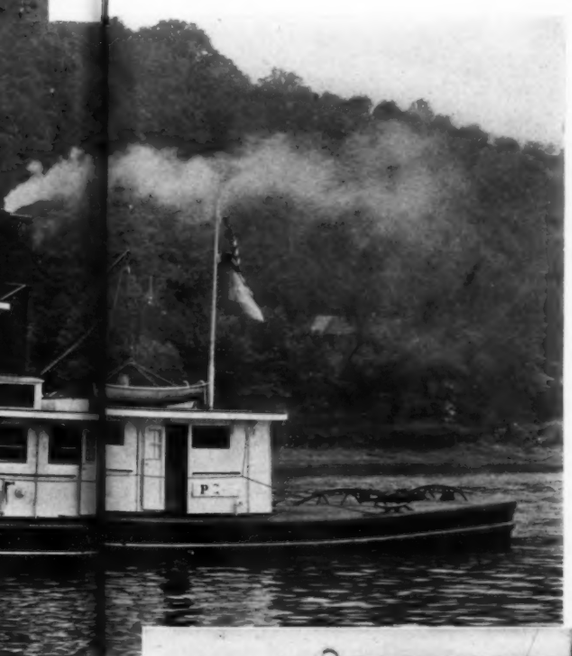
Reference to the accompanying diagrams indicates the manner in which the nozzle operates and illustrates its effectiveness. Fig. 1 shows a typical type of single screw vessel with the lines indicating the curve of the column of water as it is driven backward by the propeller. It will be noted that the movement of the water aft assumes a curved form as it approaches the propeller and that the diameter of the column continues to contract after it passes aft of the propeller. Since forward movement is given to a vessel by the push of this column against the still water aft of the ship, and since the diameter of this column of water is smaller than the actual diameter of the wheel and the water is driven aft at uneven rates of speed, the efficiency of the propeller is reduced.

Reference to Fig. 2 shows the manner in which the hydrofoil shape of the nozzle keeps the diameter of the column aft of the ship on straight lines, so that a greater area of water is asserting a rearward push to move the vessel. Tests on the various vessels upon which the Kort nozzle has been installed, which range in horsepower from 15 to 1,500, have been sufficiently thorough to provide a fund of information to show the performance which can be expected.

At normal towing speeds, an increase of towboat pull of between 20 and 35 per cent has been shown. On bollard tests, where there is 100 per cent slip, the increase is seldom less than 50 per cent.

The protective possibilities of the nozzle also are important in certain special applications. Tugs towing logs have less trouble with lines fouling in the propeller and with damage to the propeller in striking logs. Boats working in ice also have found the nozzle advantageous since it will not permit the entrance of ice cakes large enough to damage a properly designed wheel.

The usefulness of the Kort nozzle is not restricted to improving a badly designed vessel, but is used either to increase towing capacity or to reduce amount of power which must be applied to do a given amount of work to all propeller installations operating at high slip.



The top diagram indicates water flow from an "open" type hull. Below, the same hull with Kort nozzle. *Fig. 1.*

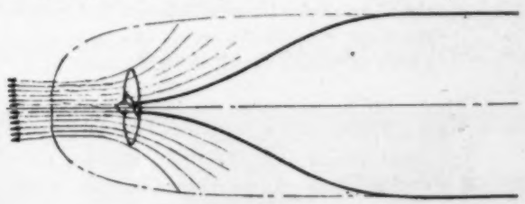
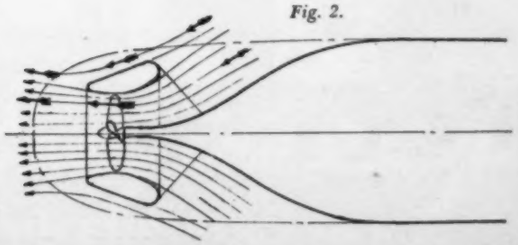
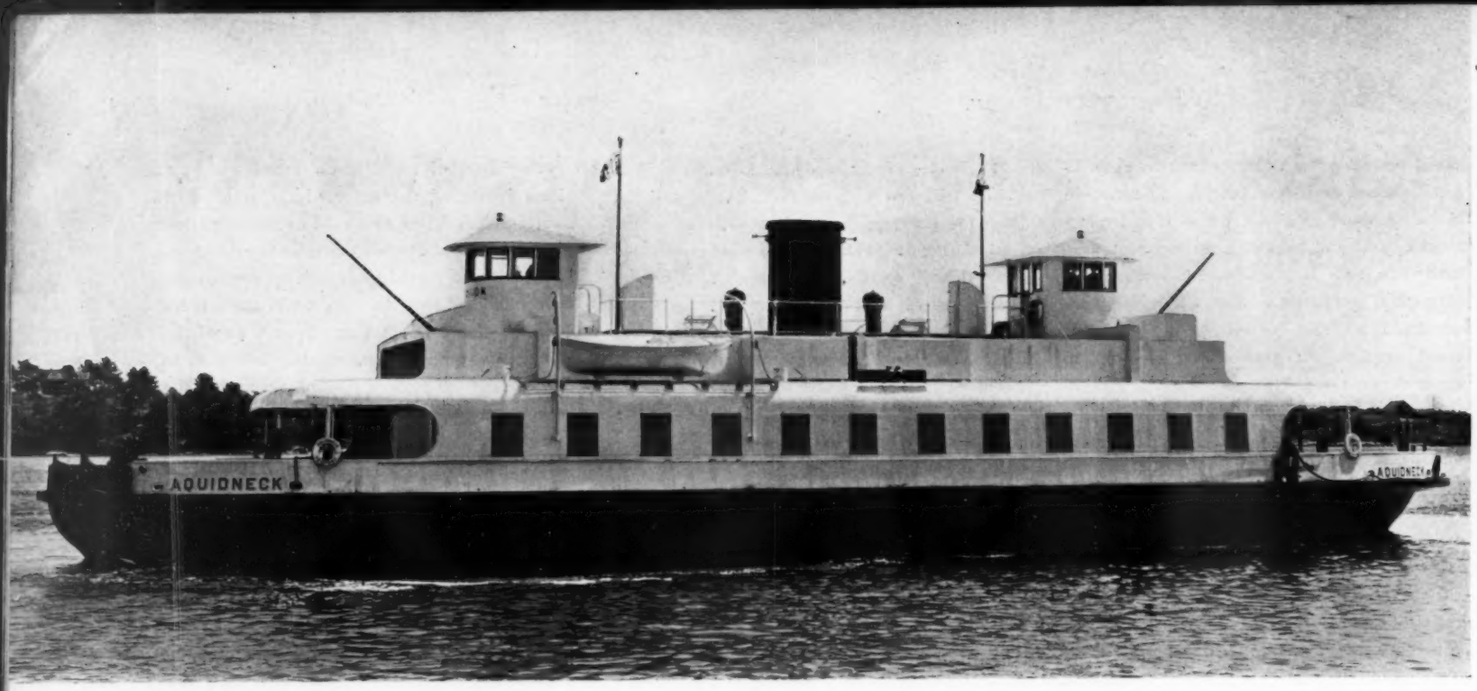


Fig. 2.





"AQUIDNECK"—A NAVY FERRY

THE United States Navy has recently taken delivery of a very interesting Diesel Electric Ferry built by the Bath Iron Works from designs by Eads Johnson. The principle dimensions of this vessel are length 151′, beam overall 53′, draft 9′ 6″, speed 11 knots.

The power plant consists of a pair of six-cylinder Winton Diesel engines direct connected to two 260 kw., 250 volts, 375 rpm. Electro Dynamic generators each equipped with an overhung direct connected 15 kw. exciter. These two generating units in turn operating a main propulsion motor 700 hp. double armature 250 volts per armature semi-enclosed, self-ventilated 150 rpm. also manufactured by the Electro Dynamic Works.

For auxiliary power two 15 kw. Winton generating sets are provided direct connected to 120-volt, 375 rpm. Electro Dynamic generators. The control equipment throughout the vessel was manufactured by Cutler-Hammer, Inc.

This compact, modern little vessel was designed for service between Newport, R. I., and the Naval Torpedo Station on what is locally known as "Goat's Island" in Narragansett Bay.

As will be seen from the illustration above the *Aquidneck* is a single deck, double-ended, Diesel electric, steel ferryboat, designed for carrying foot passengers, automobiles and trucks.

The vessel has been completed practically as it was originally designed—a double-end ferryboat with single screw at each end. Two pilot houses on upper deck, two cabins and two vehicle gangways on the main deck. The hull is of steel throughout with cast steel frames at each end. Four complete steel water tight bulkheads are provided.

One of the most interesting features of the *Aquidneck* is the method in which the runways can be closed off and protected against weather and sea. The openings for the vehicular runways at the two ends of the deck house are provided with power operated roller-type metal curtains that roll up and stow overhead. The curtains are provided with gear for hand operation in case of failure of the power mechanism. The curtains are designed to withstand a wind pressure of 30 pounds per square foot and the power gear is capable of raising the curtains at not less than ½ foot per second. These curtains are intended to protect foot passengers standing in the runways (on trips when vehicles are not carried) from wind and rain only.

The designer of *Aquidneck*—Eads Johnson—holds an enviable reputation for the successful designing of ferry boats and it was logical for the Bath Iron Works to have him prepare the design to meet the Navy Department's exacting requirements. His experience plus his established reputation for incorporating new and modern ideas into his designs is well evidenced by the results he has obtained in the *Aquidneck*.

Mr. Johnson has long been an enthusiastic Diesel electric exponent. Starting back with the Diesel electric ferries, which have been operating so successfully in New York harbor for over twelve years, he has designed and superintended the construction of more Diesel electric ferries than all other designers combined. Right now he has under construction one Diesel electric ferry for the Algiers Public Service Company of New Orleans, and one for the Westchester Ferry Company of Yonkers.

It is good to see the Diesel electric idea coming back into the public eye again. It offers so many obvious advantages for ferry operation, for tug boats, small tankers and even large cargo carriers, that it is interesting to see that the Navy has again gone back to Diesel electric control and operation.

One of the outstanding reasons for the revival of interest in Diesel electric drive is, of course, the availability of a new group of reasonably high speed, light weight and, most important of all, reasonably priced Diesel engines. In the past Diesel electric drive has always suffered from high initial first cost in comparison with direct drive. This serious objection has now been practically eliminated by the availability of this new type of Diesel, compact, dependable, low priced, with a wide range of application.

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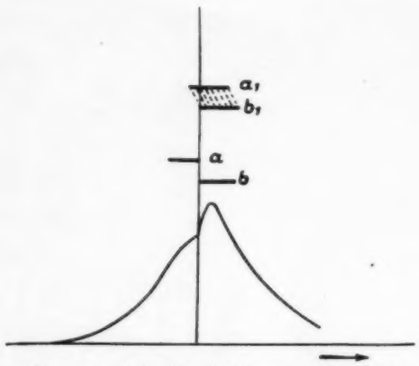
FLAME PROPAGATION IN DIESEL ENGINES

By B. J. VON BONGART

IN the not too distant past when fuel was injected by means of air-pressure, the ignition delay, i.e., the time interval required for the auto-ignition, presented difficulties, and it was held that the ignition-lag would prevent the Diesel from ever becoming a high speed engine.

With the advent of jerk-pumps, the ignition delay became secondary in importance but a new problem appeared, that of flame propagation. And with higher and ever higher engine speeds, this latter problem grows correspondingly. It is obvious that really high speeds are possible only if the flame propagation is sufficiently rapid.



($a - a_1$ = injection, $b - b_1$ = combustion)

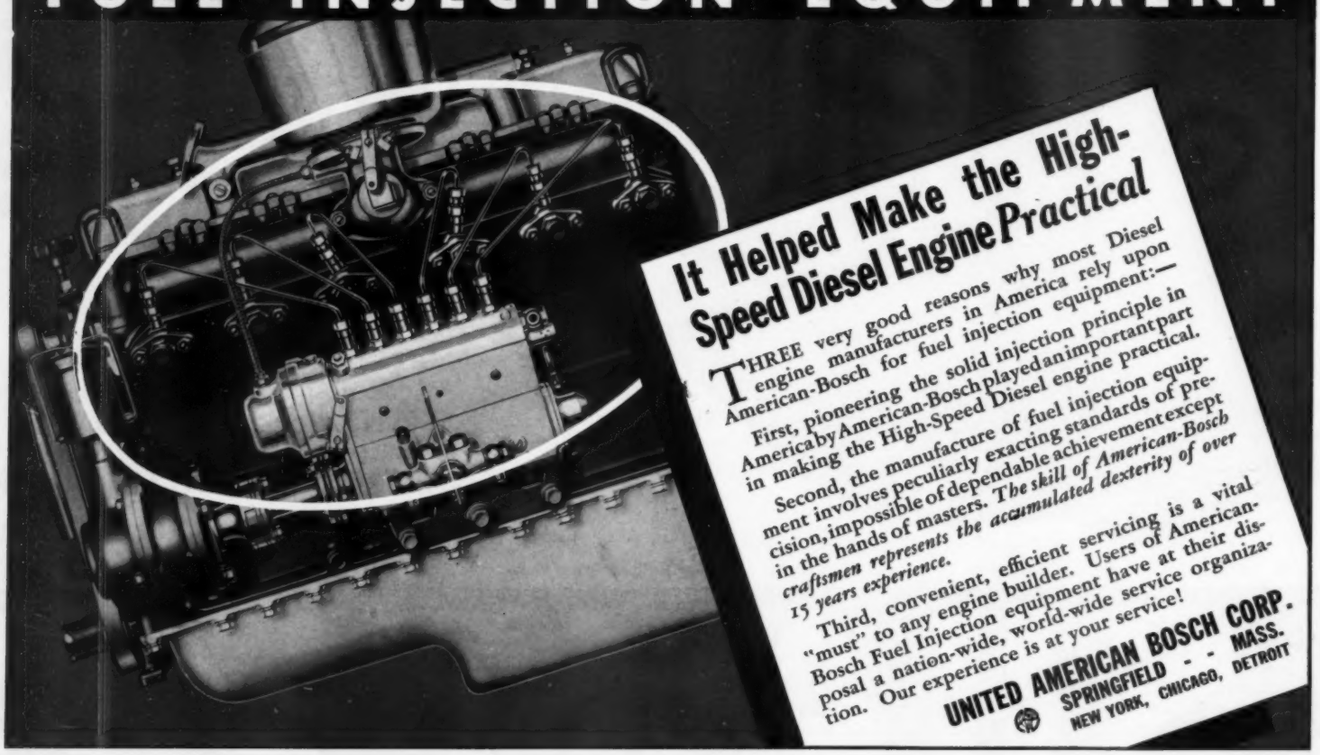
Fig. 1. Relation between fuel-injection and combustion.

Today we have two schools of thought. One proclaims that the fuel droplets must be evenly and thoroughly distributed so as to fill the entire combustion space in order that each fuel droplet may readily find its affinity, the oxygen molecule. Compressed hot air being within the combustion space, the process would begin with the injection of fuel, followed by auto-ignition and finally ending with the combustion of the fuel. Area a-b of Fig. 1.

The ignition would originate either at one point or at several points simultaneously. The flame or flames would spread with variable, if not with increasing, velocity until the entire

. . . . *And now please turn to page 54*

AMERICAN-BOSCH
FUEL INJECTION EQUIPMENT



It Helped Make the High-Speed Diesel Engine Practical

THREE very good reasons why most Diesel engine manufacturers in America rely upon American-Bosch for fuel injection equipment:—

First, pioneering the solid injection principle in America by American-Bosch played an important part in making the High-Speed Diesel engine practical.

Second, the manufacture of fuel injection equipment involves peculiarly exacting standards of precision, impossible of dependable achievement except in the hands of masters. *The skill of American-Bosch craftsmen represents the accumulated dexterity of over 15 years experience.*

Third, convenient, efficient servicing is a vital "must" to any engine builder. Users of American-Bosch Fuel Injection equipment have at their disposal a nation-wide, world-wide service organization. Our experience is at your service!

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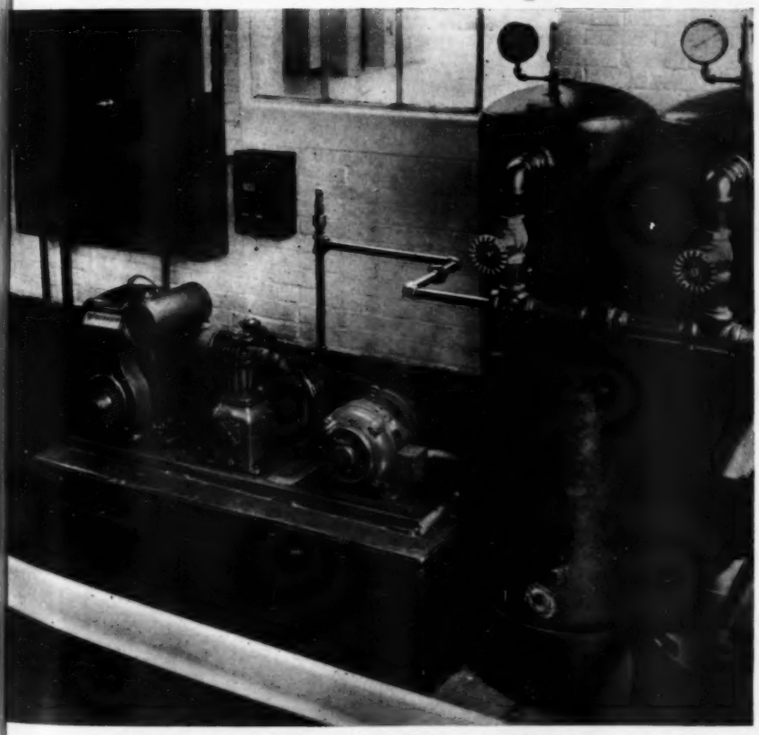
MINIMUM Power Costs Require DEPENDABLE Diesel Starting



● Compact and neat is this Diesel engine starting unit . . . a reliable Quincy Compressor, driven through multiple V-belt drive from either the electric motor or gas engine.

The people of Burlington, Kansas, are enjoying the impressive economy of Diesel power in their new municipal lighting plant. Rates to the consumer have been materially reduced. Service has been improved. In addition, the operation is delivering profits which will ultimately be reflected in lower taxes.

Two 375 h.p., five cylinder Fairbanks, Morse Diesel engines, directly connected to generators, supply the steady, low cost power distributed by this successful community-owned plant.

In order to insure unfailing starting of the Diesel engines, a Model DG-10S Quincy Compressor was chosen.

The increasing frequency with which engineers select Quincy Compressors as Diesel starting means indicates beyond all else the high efficiency and lasting dependability of these finer, stamina-built air compressors.

See page 38 for details.

WHERE AIR IS IMPORTANT

QUINCY Compressors

FLAME PROPAGATION IN DIESEL ENGINES

. . . . *Continued from page 52* . . . .

combustion space is filled with a mass of fire. The heat generated would distribute more or less evenly throughout the combustion space. Such a modus operandi would be ideal, and it would not matter whether the ignition begins within the center of the combustion space or not. If the fuel injection and the subsequent mixing of the fuel and air could be held under adequate control, then such a scheme would, in its results, approach the flame propagation of carburetted-fuel engines. It would be an ideal arrangement in so far as equal heat distribution is concerned and its net result would be a rather high brake mep., so much desired. The scheme is fascinating indeed and abroad it has found many exponents. However there are too many intransigent factors militating against its realization. To assume that the minutest of fuel droplets could ever be quickly – nay instantaneously – evenly and completely distributed within an engine's combustion chamber – similar to the distribution of water over a garden-patch by means of a sprinkling can – is too much.

The second school intends to attack the problem from a different angle. Turbulence is written upon their banner. The compressed air within the combustion chamber is to be in motion, rapid motion, and each fuel droplet as it leaves the nozzle is supposed to mate instantly with an oxygen molecule – since the latter are whirling around and around – and immediate ignition and combustion is expected as a result. Of course, here injection and combustion will be somewhat out of phase due to the ignition-lag ($a_1 - b_1$ of Fig. 1). The realization of such a proposal demands as a prerequisite that the air charge whirls around in a very definite manner so that the oxygen molecules readily meet the fuel droplets emanating in a progressive manner from the nozzle. It is a good plan, but to what extent it may be realized in actual practice, is debatable.

Comparing the demands of the two schools of thought and action, it may be stated briefly, that the former strive for an orderly and evenly distributed flame propagation over the entire combustion space area, although the flame propagation may originate at some one point only or at several points simultaneously or in steps. The second school advocates that the combustion be confined to one spot or area if at all possible and, in order that this may be realized, the fuel stream is directed to some certain spot within the engine's combustion chamber and the oxygen molecules whirling around and about are relied upon to find the fuel droplets. In other words, the combustion is to be confined to one given area, and the remainder of the combustion chamber is to be subjected to the expansive force of the combustion only. This program is not as ambitious as the former and may not be the theoretically ideal one, but it possesses this virtue: it can to a greater or less extent be realized in actual practice.

Breves* has done considerable research work in re: flame propagation, and the result of one of his experiments is shown in Fig. 2. The constants for this test were:

300 rpm., full load conditions
Inner line, $I_1 = 0.00125$ second
Outer line, $I_2 = 0.00175$ second

Irrespective of whether the engine in question is of the 4-stroke or 2-stroke cycle type, we are here concerned only with the power stroke. At a speed of 300 rpm., the power stroke of 180 degrees (crank degrees) is equivalent to a time

*L. Breves, *Forschung*, Vol. VI, p. 188, 1935.

NUGENT OIL FILTERS

Protect Diesel Streamliner M-10001

THE 1200 hp. Winton Diesel which drives "The City of Portland", crack Union Pacific train, requires lubricating oil circulation of 90 gallons per minute. That amount of oil must be completely filtered each cycle as it discharges from the pump before reaching the bearings. For this vital and continuous service three Nugent patent lubricating oil filters were selected and installed in parallel. See Figure 1398B and illustration showing the interior of the engine compartment.

Nugent filters are especially preferred for high speed Diesel railway service because of their large filtering area per floor space occupied; because there are no moving parts to replace or repair; and, perhaps most important of all, Nugent filters produce 98.8% CLEAN OIL.

Specify Nugent Oil Filters and you guarantee all bearings to be kept free from dirt, grit and carbon sludge.

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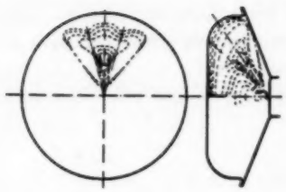


Fig. 2. Flame propagation, speed 300 rpm.

factor of 0.1 second. Since Breves established that it required 0.00175 second for the flame to propagate to the outer line, I_2, so is this equivalent to a crank movement of 3.15 degres of travel. If we now visualize a truly high speed Diesel operating at 4,000 rpm., the crank travel would be 13.33 x 3.15 degrees or 41.9 degrees. Manifestly, that would make high speed Diesel engines impossible. Fortunately, such is not the case as is depicted in Fig. 3.

Here the constants were:

500 rpm., full load conditions
Inner line, $I_1 = 0.00095$ second
Outer line, $I_2 = 0.00155$ second
Beneath nozzle = 0.00105 second

At a speed of 500 rpm., 180 degrees of crank travel takes place within 0.06 second, hence the flame propagation to the outer line I_2, is equivalent to 4.65 degrees of crank travel. Again, if 0.00155 second were the irreducible minimum for flame propagation, then for an engine speed of 4,000 rpm. the factor would be 8 x 4.65 or 37.2 degrees of crank travel. While this indicates a considerable reduction compared to Fig. 2, yet it is manifest that the flame propagation must advance with far greater rapidity in high speed engines.

In comparing the results obtained at 300 rpm. with those of 500 rpm., a few factors stand out in bold relief. The 66 per cent increase in speed reduces the time of flame propagation to the inner line I_1 from 0.00125 second to but 0.00095 second or by 24 per cent, whereas the reduction for the outer line I_2 is from 0.00175 second to only 0.00155 second, a margin of but 11½ per cent. We have not sufficient data to plot a curve that would illustrate the progressive reduction of the time factor of flame propagation at higher speeds, but that high engine speeds in themselves reduce the time factor — up to a certain optimum point — may readily be accepted, for if this were not so, then engine speeds of 3,000 rpm. and over would not be possible.

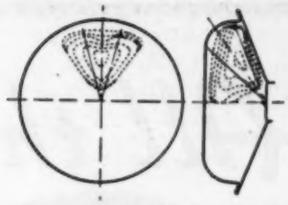


Fig. 3. Flame propagation, speed 500 rpm.

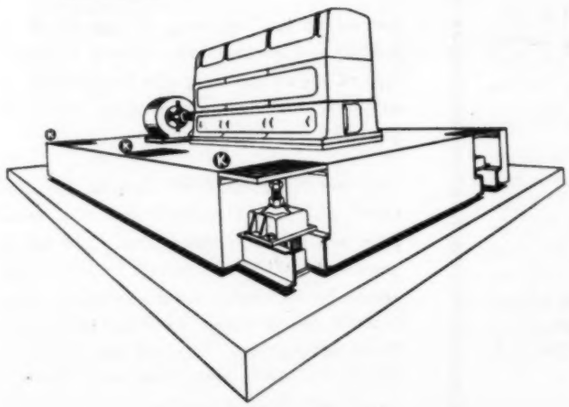
Should it puzzle the reader that a mere increase in engine speed manifest itslef in accelerated flame propagation, the phenomenon may be explained thus.

As is well understood, the heat of the compressed air charge is the direct cause for the auto-ignition, but the rapidity with which this heat is generated, determines not only the duration of the ignition lag but also the velocity of the flame propagation, other things being equal.

Breves in his experiments confined himself to single-nozzle fuel injection. For years past, twin injection nozzles have been used by a score of Diesel engine manufacturers. Of course, in the majority of cases, this was necessitated by the largeness of the cylinder bore of the engine — the penetrating power of the fuel-

KORFUND *Isolates all* Diesel Vibrations!

Drawing shows application of Korfund Vibro-Dampers (K) to typical Diesel installation.



Hundreds of successful installations demonstrate KORFUND'S ability to eliminate the transmission of vibrations from all types of Diesel engines—"isolating" them **at their source!** Here are a few recent applications of KORFUND Anti-Vibration Products, illustrating their wide adaptability to varying conditions.

LOCATION	ENGINES	No.Cyl.	H.P.	R.P.M.	KORFUND
2 Park Avenue, N.Y.C.	3 Worthington	6	450	327	36 Type U Vibro-Dampers
Sailors Snug Harbor, N.Y.C.	2 Nordberg	6	300	400	20 Type U Vibro-Dampers
Lone Star Gas Co., Dallas	1 Cooper-Bessemer	8	400	400	12 Type U Vibro-Dampers
Marquette Metal Prod., Cleveland	2 Winton	3	25	600	12 Type D Vibro-Dampers
Kent's Restaurant, Atlantic City	1 National Superior	6	43	1200	4 Type D Vibro-Dampers
Village of Rockville Centre, L.I.	2 Alco	8	2850	120	Natural Cork Plates
Hotel New Yorker, N.Y.C.	1 De La Vergne—	8	530	277	Natural Cork
	1 Busch Sulzer	6	750	300	Plates
Hotel Seville, N.Y.C.	4 Buda	6	105	1200	20 Type U Vibro-Dampers

If you are planning a Diesel installation, you can **eliminate** your vibration worries by using KORFUND Anti-Vibration Products. Send coupon TODAY for our instructive booklet, ISOLATION!

THE KORFUND COMPANY, Inc.
48-26 32nd PLACE • LONG ISLAND CITY

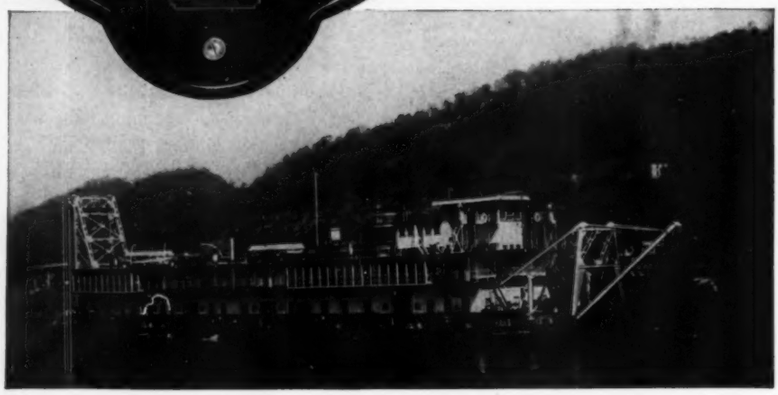
THE KORFUND CO., INC.
4826 32nd Place, L.I. City, N.Y.

Please send me copy of your booklet, ISOLATION.

Name .....
Firm .....
Address .....
City ..... State .....

All three

"JEWETT"
"WM. A. THOMPSON"
"ROCK ISLAND"



...EQUIPPED WITH WESTON *Electrical* TACHOMETERS

Bridge view, showing WESTON Electrical Tachometer Indicators on the "Jewett."

Engine room view, showing WESTON Electrical Tachometers on the "Wm. A. Thompson."

The three new U. S. Army Engineers dredges . . . the "Jewett" and "Wm. A. Thompson" already in service, and the "Rock Island" to be completed this month . . . are equipped with dependable WESTON Electrical Tachometers.

Sturdy WESTON Magnetos are mounted on the generator engines of these dredges, with simple wiring connections up to the WESTON Electrical Indicators mounted in the engine rooms. In the case of the "Jewett," WESTON Indicators also are mounted far remote on the bridge.

Duplicate, as well as remote indication is possible because with WESTON Tachometers all connections are electrical. No flexible shafting is used. And this same virtue of electrical indication assures instant and smooth response to speed changes . . . dependable accuracy . . . and low maintenance. Complete information on the advantages of electrical indication is available . . . Weston Electrical Instrument Corporation, 579 Frelinghuysen Ave., Newark, N. J.

WESTON *Instruments*

stream being definitely limited — rather than being motivated by a desire to hasten the flame propagation, since for large, slow-speed engines, flame propagation is not a momentous issue.

A certain European manufacturer who for years had used twin injection nozzles is now fitting four injection nozzles.

The result is a 25 per cent increase in engine speed (but it must be said that the weight of the reciprocating parts was also reduced), the brake mep. has risen from 84 to 110 lbs. per sq. inch and the fuel consumption reduced from 0.38 lb. to but 0.34 lb. per hph. The engine thus operating with an efficiency of 40 per cent!

The achievement of such remarkable results is directly due to the intimate mixing of the fuel-air charge on account of the multi-nozzle arrangement, and the rapid flame propagation thus secured manifesting itself in a high brake mep. and the very low fuel consumption thus obtained represents about the very best thus far realized.

But whether such highly sophisticated engines are suitable for continuous everyday service is a question. The fuel injection pressure used in connection with this engine is of the order of 15,000 lbs. per sq. inch — so that minute fuel atomization may be attained — which represents an excessively high figure, and four fuel nozzles per cylinder does not exactly spell simplicity.

For all services requiring the utmost of reliability and freedom from tinkering, a simpler type of engine operating with less efficiency as to power and fuel consumption, would be preferable.

Yet, there is a consistent demand for high speed performance coupled with high brake mep. and low fuel consumption. The logical procedure would be to attempt to secure these results by an engine design fostering turbulence of the air charge, so as to obtain rapid flame propagation. Lowered fuel consumption and a rise in brake mep. would be incidental and follow as a matter of course. One should never complicate matters however.

Comprehensive research in the field of flame propagation would indeed by fruitful. Once the cardinal requirements have been established, the appropriate means for the realization of truly high speed performance will perhaps suggest themselves.

ALDON PNEUMATIC VALVE GRINDER

SINCE practically every Diesel engine plant has compressed air available, the new pneumatic valve grinder illustrated above will be of great interest to Diesel owners and operators. There are four chief advantages to this handy and compact little unit which should recommend it highly to the industry.

The grinder is especially light in weight, 28 ounces to be exact, and is extremely sensitive in operation. It is possible for the user to feel when the valve is properly seated and thus avoid the danger of "ringing."

Since the present day hardened seats require high speed abrasive action, the Aldon unit is designed to give any speed desired between 600 and 6,000 strokes per minute.

As the valve being seated is rapidly oscillated, it automatically is moved forward one sixth of a turn at each stroke thus eliminating high spots and valleys which comprise one of the meanest problems of hand grinding.

The fourth "high point" about this machine is the simplicity of construction. There is not a single cam or gear used any where in the mechanism and wearing parts have been reduced to an absolute minimum.

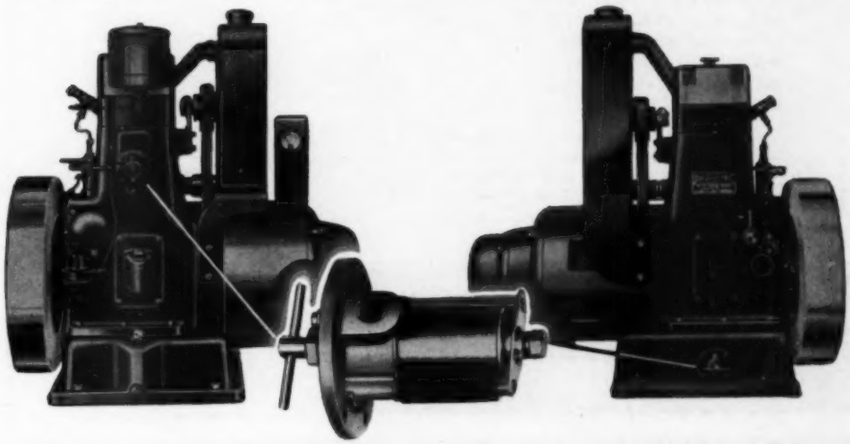
The case is formed of aluminum which contributes materially to the light weight. The spindle carries a ball-bearing thrust and the steel piston is ground and fitted to a tolerance of 0.0005 of an inch. For further information address inquiries to The Editor.

GOING TO STATE COLLEGE AGAIN?

THE oil and Gas Power Division of the A.S.M.E. is going back to State College, Pa., again this year for their annual meeting. The first session opens on Wednesday, August 18th, and the meeting runs through to Saturday, August 21st.

Reservations at the Nittany Lion Inn, State College, Pa., are already at a premium. Special inclusive rates have been arranged for and details can be obtained from the Inn or from M. J. Reed, 2 West 45th Street, New York City, who is again acting as secretary of the Division. A limited number of exhibit spaces will again be available in the dining room, and at very reasonable rates. Floor plan and full data may be obtained by writing Mr. Reed.

The technical program is now being worked out and full details will appear in our July issue at which time any additional information pertaining to the convention will be given. Remember the dates—August 18th through August 21st.



CLEAN OIL *Continuously* ···and the CUNO

Filters are integral features of this Diesel Unit

• The specialized application of CUNO *Continuously Cleanable* FILTERS to modern Diesel engines is strikingly reflected in the new Witte Vertical Diesels shown here. Witte engineers now offer Diesel power in its smallest, most compact form . . . and, logically enough, both fuel and lubricating oil systems are CUNO equipped. Here, the menace of shut downs and premature wear due to foreign solids which commonly contaminate Diesel fuel and lubricating oils is definitely eliminated. The CUNO Auto-Klean FILTERS which are integral, standard equipment features of these notable new engines, as well as many others, offer constant protection. And, these FILTERS are *Continuously Cleanable* while in service without any interruption of flow or power production.

It is this steady, uninterrupted dependability that marks CUNO the ideal unit for every Diesel power plant.

We'll be glad to show you specifically how these compact, versatile units will save you expense on pumps, valves, liners, rings, and bearings . . . and, provide freedom from the threat of dirty oil and shut downs. Ask for the facts.

Schematic section of a typical CUNO FILTER showing direction of flow. Your substance enters the filter case and passes under gravity, pressure or suction head through the closely spaced filtering discs which catch the suspended solids. Then, rotation of the entire element, either manual or mechanical against the stationary cleaning blades combs out the filter and drops the unwanted substance to the ample sump below. The filtered and cleaned substance rises through the interior of the cartridges and passes out through the outlet indicated.

CUNO

ENGINEERED FILTRATION

CUNO ENGINEERING CORPORATION - MERIDEN, CONN.

CUNO ENGINEERING CORPORATION
Dept. 60, 290 So. Vine St.
Meriden, Connecticut

Gentlemen: Please send me bulletin of CUNO FILTERS for service on _____

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and information on your confidential engineering service.

Name _____

Address _____

City & State _____

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Viking is proud of its close association with the Diesel Industry . . . proud of the enviable reputation that Viking Pumps have earned through their many Diesel assignments:

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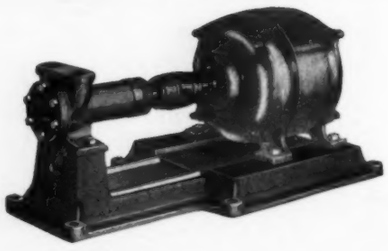
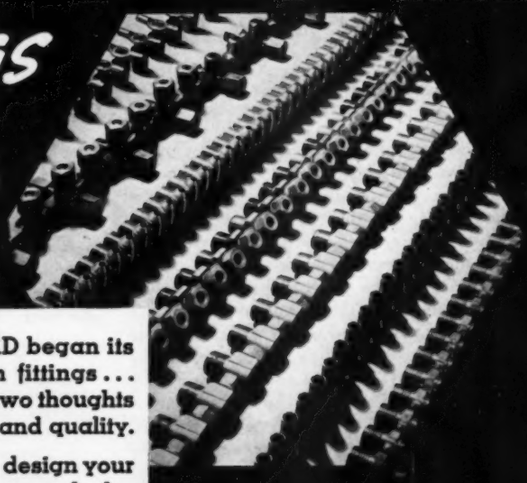
- Fuel Oil Transfer Pumps
- Auxiliary Injection Pumps
- Centrifuge Pumps
- Scavenger Pumps
- Vacuum Service Pumps
- Cooling Water Pumps
- Hand Emergency Pumps
- Tank Car Unloading Pumps

If you're confronted with any tough Diesel pumping problems, get in touch with Viking. Write for bulletins on Viking Pumps that have been especially designed and fitted for Diesel Service.



VIKING PUMP CO.
CEDAR FALLS, IOWA

Fittings BY SPECIALISTS



WEATHERHEAD began its business with fittings . . . designed with only two thoughts in mind . . . accuracy and quality.

Today—whether you design your own and have them made by Weatherhead—or select any Weatherhead diesel fitting you'll find . . . accuracy and quality.

In addition to fittings, Weatherhead also supplies all forms of screw machine products. Estimates will be gladly supplied for your specifications.

WEATHERHEAD
CLEVELAND, OHIO

POLISH LINE ADDS TWO NEW DIESEL LINERS

SUCCESS of the Gdynia America Line's South American service, started early in 1936 as an experiment, has resulted in the letting of contracts for two new high speed Diesel motor driven sister ships to replace the *Pulaski* and the *Kosciuszko* now making that run from Gdynia. One will be built at Swan Hunter, Newcastle on the Clyde, England, and the other at Nekskove, Denmark. Unlike the other two new motorships, *Pilsudski* and *Batory*, which were built by Italy for the Line on a barter arrangement for Polish coal, these ships were contracted for on a cash basis.

Geared to make 17 knots an hour, the new vessels are expected to make the run from Gdynia to Rio de Janeiro in 14 days, as against the 19 days now required by the older ships, capable of making only 13 knots. Delivery is planned for October 1938 and May 1939, respectively.

Success of the *Batory* and the *Pilsudski*, both Diesel motor driven and in the North Atlantic run between New York and Copenhagen and Gdynia, prompted the Line's experts to specify Diesel propulsion for the new vessels. It has proven not only mechanically more efficient but saves space. At the height of the tourist season it is probable that the two new ships will be used to relieve the pressure on the *Batory* and *Pilsudski*.

SUPPLY LIMITED

WE now have but fifty-seven copies of the *Standard Practices* left on hand. This book has enjoyed a remarkable sale. It was published by the Diesel Engine Manufacturers Association late last year and has become the bible of the consulting engineer, Diesel salesman and prospective Diesel engine user.

And logically so, it contains a mass of vital information pertaining to standard performances, equipment and definitions. The cost of Diesel power. The selection of engine sizes for a given load. Power plant buildings. Engine construction. Governors and speed regulation. Erection data. Fuel oil storage and handling. Lube oil systems. Cooling water systems, etc., etc. Everything you need to know on Standard Practices—and the price of this unique book is but TWO DOLLARS. Subject to the supply now on hand we offer our readers this book—and heartily recommend it to them.

DIESEL PROGRESS, 2 W. 45th St., New York

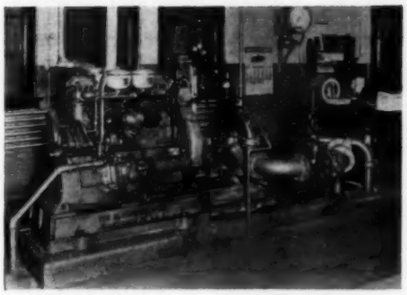
Enclosed find $2.00, send me a copy of *Standard Practices* postpaid.

Name .....

Address .....

.....

FIRST AUTOMATIC DIESEL PUMPING STATION COMPLETES FULL YEAR'S OPERATION



DURING the past winter, the Municipal Pumping Station at North Easton, Massachusetts completed its first full year of operation with power supplied entirely by Hercules Diesel Engines. This station was the first in the country to have a fully automatic, Diesel-Driven centrifugal water pumping unit.

The unit consists of a 600 gpm. Aldrich centrifugal pump directly connected to a six-cylinder, 4⅜" x 5¼" Hercules Diesel Engine—operating at 1400 rpm.

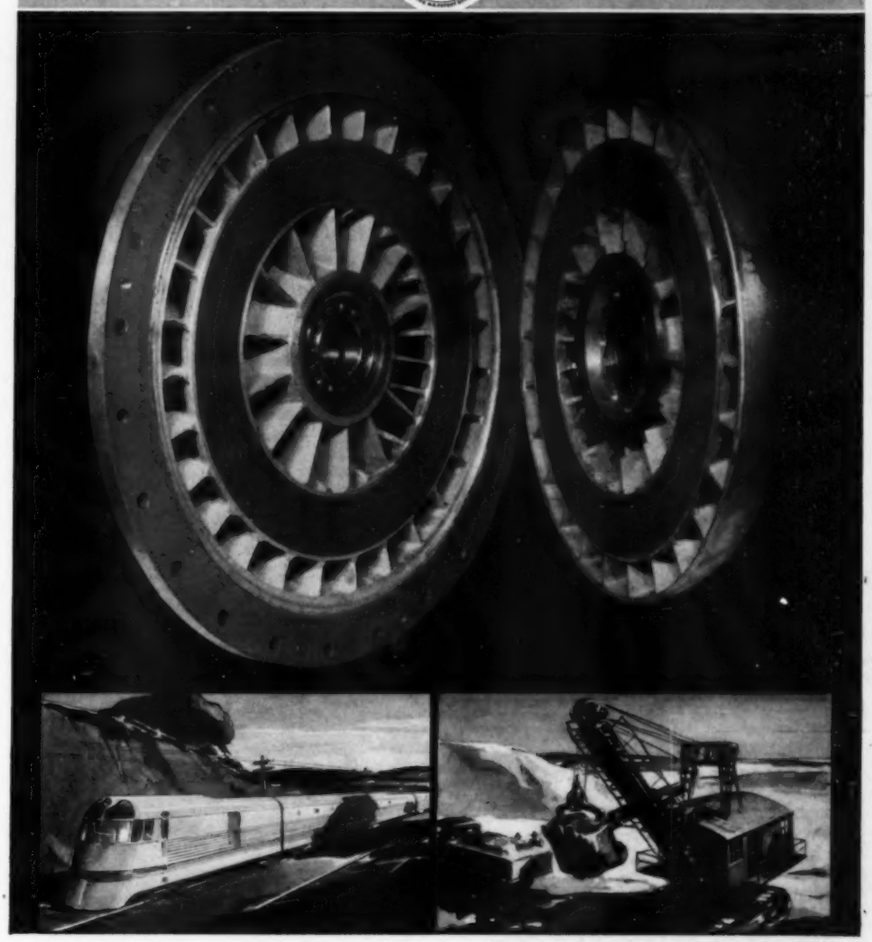
The results of the first year's operation proved the complete satisfaction of Diesel power for pumping station installations. According to George B. Bailey of The Thermal Engineering Company, which made the installation, the Diesel engine has required a minimum of maintenance expenditure while operating over a period of more than 1800 hours, and starting and stopping six to eight times daily. With a fuel cost of 5½c per gallon, the Diesel Unit operates at a cost equivalent to electric power at less than ½c per kw. hour.

The automatic feature of the plant is a decided step forward in Diesel engine water pumping. Prior to the development of the special automatic control equipment the continual presence of an attending engineer was necessary. At the North Easton plant the automatic controls have released the engineer for other duties and consequently effected a considerable savings in operating costs.

The plant not only maintains automatically the desired pressure differential in the pumping system, but supplies as a by-product all the heat required to maintain the pumping station temperature at 70 degrees.

The Thermal Engineering Company of Boston has since made several similar installations, using Hercules Diesels to supply automatically controlled power for industrial concerns. In each of these installations the results have been highly satisfactory, with maintenance costs reduced materially.

VULCAN SINCLAIR FLUID TRANSMISSION



FLUID DRIVES for DIESEL POWER

Wherever the Diesel engine is used—in rail service—in the shovel, drag line, excavator, oil well drilling—or on the sea—it will perform its duties more smoothly and more economically when equipped with a Hydraulic Coupling.

More smoothly—because there is no mechanical connection between the driving and driven members of the Hydraulic Coupling. Power is transmitted by the kinetic energy of oil which circulates through radial passages formed in the two rotating elements. It does not transmit torsional vibrations and shocks. IT IS TRULY A FLUIDRIVE.

An important characteristic of the hydraulic coupling is its ability to prevent engine stalling when the latter is subjected to overload. As there is no decrease in torque in the coupling, normal torque, corresponding to reduced engine speed, is delivered to the stalled driven shaft. This feature is of particular value in the case of power shovel and slush pump drives.

In marine service the hydraulic coupling prevents the transmission of torsional vibrations, permits rapid clutching and declutching, and prevents the operating characteristics of one engine from interfering with another, where both supply power to a common service.

For technical information or recommendations covering these and other applications phone or write.

HYDRAULIC COUPLING DIVISION
AMERICAN BLOWER CORPORATION
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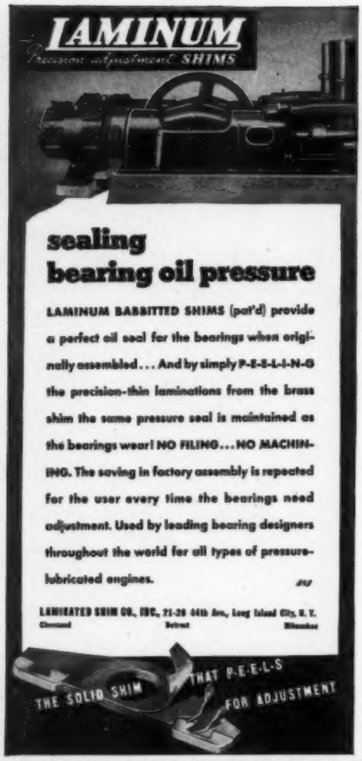
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Precision adjustment SHIMS
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LAMINUM BABBITTED SHIMS (pat'd) provide a perfect oil seal for the bearings when originally assembled... And by simply P-E-E-L-I-N-G the precision-thin laminations from the brass shim the same pressure seal is maintained as the bearings wear! NO FILING... NO MACHINING. The saving in factory assembly is repeated for the user every time the bearings need adjustment. Used by leading bearing designers throughout the world for all types of pressure-lubricated engines.
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ALL DIESELS

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● BUT — To do this year in and year out with a minimum of attention, a minimum of repair expense and to give reliable power is something else.

Such dependable and trouble-free service is built in Buckeye Diesels. Their smooth steady operation is a result of their conservative design and construction.

Let us tell you more about these outstanding Diesels and how they make for greater economy through longer engine life and lower maintenance costs.

Write today on your letterhead.

Sizes 40 hp. up to 600 hp.

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Engine Builders Since 1908

Lima, Ohio

NEW STREAMLINER

CONSTRUCTION of the largest and most powerful streamliner yet designed, to replace the present *City of San Francisco* on the San Francisco-Chicago run, will be started soon, according to announcement by the Southern Pacific Company.

To be completed early next year, the new train will cost in the neighborhood of $1,500,000, and will be owned and operated jointly by Southern Pacific, Union Pacific and Chicago & North Western railroads, it was stated by A. D. McDonald, president of Southern Pacific.

The Union Pacific and Chicago & North Western, McDonald said, will build a similar train to take the place of the present *City of Los Angeles.*

The new *City of San Francisco* will be a 17-car train instead of 11-car as at present, and will have nearly 50 per cent more capacity for Pullman passengers. It will carry one coach.

There will be three power cars, each housing twin Diesel-electric units, with a total of 5,400 hp., whereas the *City of San Francisco* now in use has only 2,400 hp. The new train will measure 1,264 feet, or just short of a quarter of a mile.

Passenger equipment, it was stated, will be featured by a duplex bedroom car with 17 rooms, and a two-unit diner, one car having 64 seats and the other containing the kitchen and a 32-seat coffee shop. A full observation-lounge car, with cocktail bar, a barber shop and shower bath, will be carried at the rear. Club room facilities will be provided near the head end of the train.

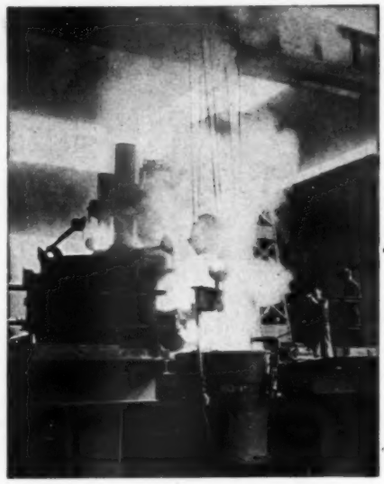
The train will have accommodations for 174 Pullman and 54 coach passengers, a total of 228. The present *City of San Francisco* has a capacity of 170, 84 in Pullmans and 86 in two coaches.

The complete makeup of the train will be as follows: Three power cars; one baggage car, with dormitory for diner crew; one combination baggage and club car; one 54-seat coach; the two-unit diner; two four-compartment, three-drawing-room cars; three 12-section Pullmans; one 14-section Pullman; one 10-room bedroom car; one duplex bedroom car, with 17 rooms, and one observation-lounge car.

The new *City of San Francisco,* it was stated, will carry on the present 39¾-hour schedule, which enables passengers to make the 2,264-mile trip between San Francisco and Chicago in only one day and two nights.

National Forge and Ordnance Company

Irvine, Warren County, Penna.



All National Forge and Ordnance Company products are manufactured from fine quality Basic Electric Steel.

Complete control of all processing from selection of the melting charge to the finished condition is National Forge and Ordnance Company's guarantee for maintenance of quality in crankshafts and various other types of forgings furnished to leading manufacturers in the Diesel industry.

BASIC ELECTRIC STEEL FORGINGS

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Carbon, Alloy, Corrosion Resistant and Special Steels Smooth Forged, Hollow Bored, Rough or Finished Machined, Heat Treated to Specifications. . . Forging Quality Ingots Pressed or Hammered Billets.

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For fuel and lubricating oils

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Seneca Falls, N. Y.

DIESEL APPLICATION PLAN BOOK, Volume I., John W. Anderson, Editor. 300 pages, 9″ x 12″ plastic binding, profusely illustrated, depicting in blue print form actual installations of Diesel engines in over one hundred separate and distinct applications. Additional chapters on intake and exhaust systems, fuel oil storage and handling systems, lubricating oil systems, cooling water systems, Diesel power plant buildings, Oil Well rigs, etc., etc. A very popular and valuable book. $3.50 postpaid.

DIESEL ENGINES, INC.

2 West 45th St. New York City

HYDRAULIC ENGINEER VISITS AMERICA

MR. HAROLD SINCLAIR, managing director of Hydraulic Coupling & Engineering Co., Ltd., Fluidrive Works, Worton Road, Isleworth, England, arrived by the "Queen Mary" on the 3rd of May with the principal object of receiving the Edward Longstreth medal awarded by the Franklin Institute of the State of Pennsylvania for his work in the adaptation of the Fottinger type hydraulic coupling to variable speed drives in industry.

A further object is to interchange experience concerning general industrial, also rail and road traction applications of the Vulcan Sinclair fluid coupling with the Hydraulic Coupling Division of American Blower Corporation, Detroit, which is active in these fields. Mr. Sinclair was born in Durban, South Africa, in 1898 and received his early technical training at the Natal Technical College. He was nine years on the engineering staff of Vickers Ltd., London, and has been actively engaged since 1928 in the development of the fluid coupling from the original form in which it was produced for marine propulsion by the Vulcan-Werk of Hamburg; and the first prominent success was its adoption in May, 1930, by the Daimler Company of Coventry, England, for motor car and city bus transmissions under the name "Fluid Flywheel" which has become a household word among motorists in that country.

The fluid coupling is being largely used as an automatic "clutch" for a variety of drives such as Diesel engined excavators, winches, and compressors, also as an easy starting and non-stalling feature for squirrel cage motor drives to capstans, conveyors, centrifugals, bucket dredges, and broadly to all purposes where shock loads or heavy starting conditions are encountered.

In the rail traction field, the fluid coupling has contributed materially to the success of the Diesel engine with mechanical transmission and a number of the South American railway companies have virtually standardized "fluidrive" for their rail cars. In Italy the Ernesto Breda Company has built several score of rail cars on this system, and in France the Michelin Company is making rapid strides with fluid couplings and epicyclic transmissions in their pneumatic tired cars. England, Holland, and Germany were the first European countries to recognize the merits of "fluidrive" for rail service and rapid progress results from the free interchange of experience between the Old and New Worlds, which is one of the objects of Mr. Sinclair's mission.

DIESEL POWER — Engines, Generator Sets

• COMPLETE PLANTS •

1250 H.P. Nordberg (2)
840 H.P. Fairbanks-Morse (2)
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200 H.P. DeLaVergne (2)
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130 H.P. DeLaVergne (1)
110 H.P. Anderson (1)
100 H.P. Standard (1)
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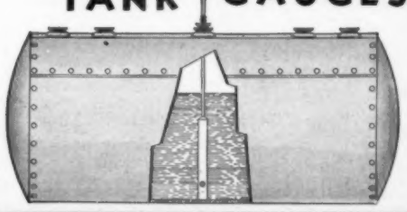
PETROMETER DISTANT READING TANK GAUGES

For the BEST DIESEL INSTALLATIONS

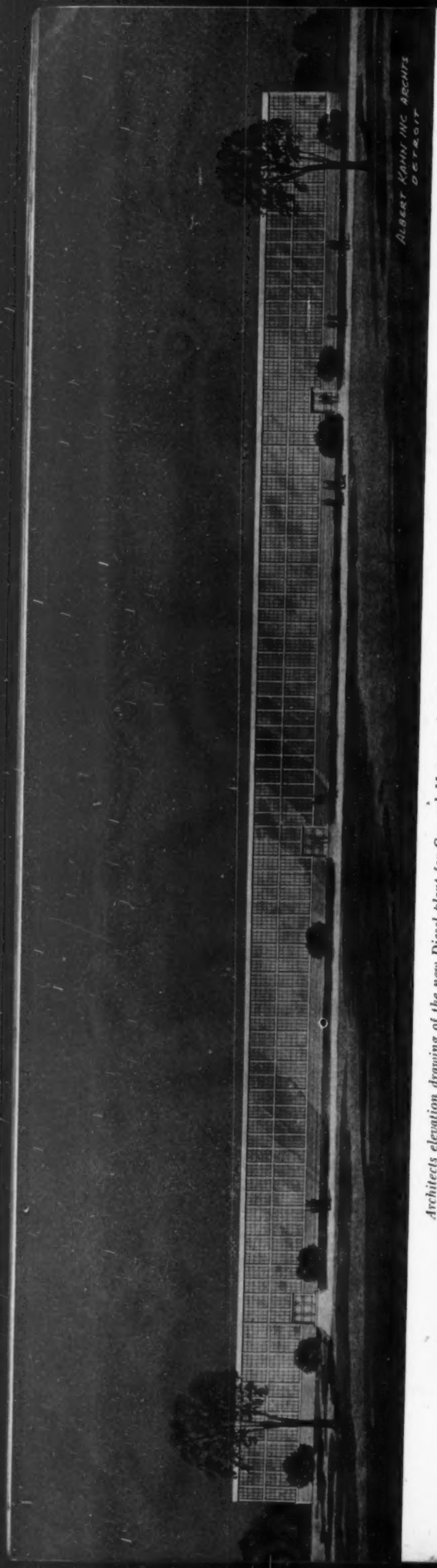


PETROMETER CORP.
1 Star Sq., Long Island City, N. Y.

Dr. Shush successfully prescribes Model DO4 (2 cycle type) MAXIM SILENCERS for the exhausts of the two Fairbanks-Morse Diesel Engines at the Burlington, Kansas, Power plant

■

The MAXIM SILENCER CO.
Hartford, Conn.



Architects elevation drawing of the new Diesel plant for General Motors. Actual construction is to start this month in Detroit.

Mr. W. T. Crowe, who will be in charge of the new plant as General Manager.

NEW GENERAL MOTORS DIESEL DIVISION

THE formation of a new Division, to be known as the Diesel Engine Division of General Motors Corporation, is announced by Chairman Alfred P. Sloan, Jr. The new Division will manufacture a line of Winton Diesel engines, beginning with a 20 hp., single-cylinder unit up to a 160 hp., six-cylinder unit. Single-cylinder units are designed for stationary use only whereas multi-cylinder units are all adaptable to marine, stationary or commercial vehicle use. The manufacture of Diesel engine fuel injectors which has been carried on in the General Motors Research Laboratories for the past several years will be moved to the new plant, as soon as possible. A seventy-five acre tract of land, located at the intersection of the Pere Marquette Railroad and Outer Drive, Detroit, has been purchased and erection of a new plant will be started at once. The first building to be erected will be an engineering laboratory in which all development and test work on Diesel engines for Winton Engine Manufacturing Corporation and Electro-Motive Corporation, as well as for the new Division, will be carried on. This laboratory will also contain a Diesel-electric power plant for supplying all power to the manufacturing plant. Mr. W. T. Crowe has been appointed General Manager of this Division.

NEW BUDA DIESEL

THE Buda Company, of Harvey, Illinois, announces a new six-cylinder marine engine, known as Model 6-LDM-1742-C. This engine is designed for large yachts, work boats, and fishing craft. It is equipped with the "Capitol" Reduction Gear as standard equipment, making a specially sturdy unit for heavy duty service.

The engine is four-cycle, full Diesel, airless injection, with 6½ in. bore by 8¾ in. stroke. It develops 158 hp. at 800 rpm., 188 hp. at 1,000

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CAUTION-

TO ALL PROSPECTIVE DIESEL STUDENTS:

- Remember this fact — that in whatever school you enroll you are spending YOUR time, effort and money to prepare yourself for opportunities in the Diesel field and the value of your training will depend upon the STANDING OF THE SCHOOL OF YOUR CHOICE, and the RECOGNITION IT ENJOYS WITH THE DIESEL INDUSTRY AND EMPLOYERS THROUGHOUT THE NATION.
- The Hemphill Diesel Schools are the original and exclusive Diesel Schools in the United States and Canada. They are recognized from one end of the country to the other, not only for the quality of equipment and the training, but for the care used in the selection of students.
- We do not accept students without references as to qualifications and character We will not even tell you that you should consider Diesel IF YOU ARE THE TYPE OF MAN WHO IS SWEPT OFF HIS FEET BY IMPOSSIBLE CLAIMS AND PROMISES, YOU ARE NOT THE TYPE WE DESIRE. Analyze yourself, first, — then observe the tremendous growth and development of the Diesel field. If you then believe it offers you opportunities, get a Diesel training. Investigate other Diesel schools—investigate Hemphill Diesel Schools—by all means make a thorough investigation—then use your own judgment.

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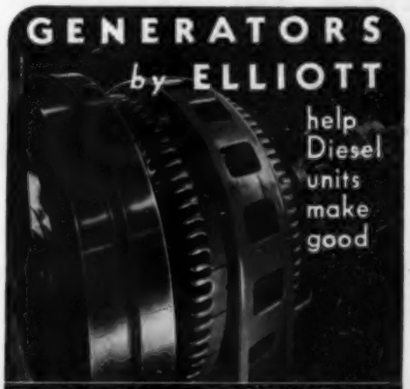
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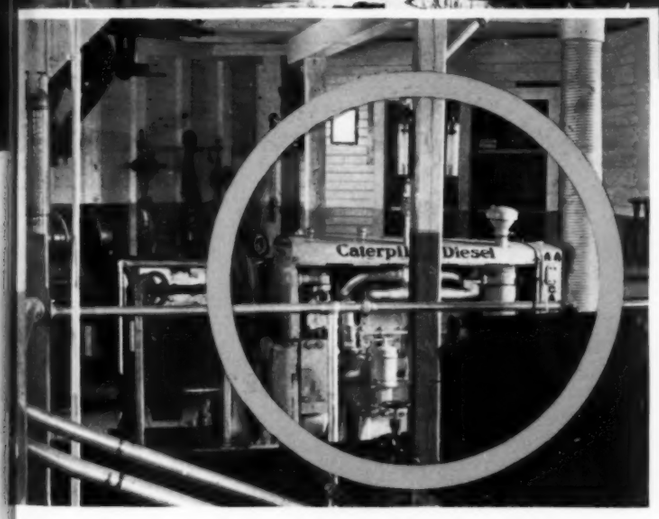

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